HOW DOES FOOD LITERACY AFFECT FRUIT AND VEGETABLE CONSUMPTION AMONG CANADIAN ADOLESCENTS?

by

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Abstract

Background. Adolescents are losing the opportunity to observe and practice food skills since diets are shifting from home prepared meals made from basic ingredients to a diet comprised of ultra-processed foods, resulting in reduced consumption of minimally processed foods such as fruits and vegetables. Evidence suggests that engaging in food preparation during adolescence is associated with ongoing healthy dietary behaviours and food preparation practices into adulthood, thus developing food preparation skills in adolescence may help better support individuals to make health informed food choices. Food literacy represents the interdependent concepts related to the facets influencing dietary practices. The objective of the current study was to examine the association between food literacy and fruit and vegetable consumption (FVC) among Canadian adolescents.

Methods. Guided by the food literacy framework developed by Thomas et al. (2019), a secondary analysis was conducted on the Canadian Community Health Survey, Rapid Response on Food Skills (Part 2) – mechanical skills and food conceptualization. The sample population (N=790) included all survey respondents aged 12- 17 years who responded to the survey questions that built the outcome variable: total daily fruit and vegetable consumption.

Results. When compared to respondents who report low levels of food skill, respondents who reported high food skill levels in the ability to cook from basic ingredients (OR 1.84, 95% CI 1.12-3.02), freeze vegetables from raw (OR 1.50, 95% CI 1.00-2.24), and to adjust a recipe to make it healthier (OR 3.02, 95% CI 1.29-3.26) were more likely to consume fruits and vegetables five or more times a day. Respondents who came from households where the highest level of household educational attainment was trades had lower odds of consuming fruits and vegetables five or more times a day compared to households where the highest level of educational attainment was a bachelor's degree or higher (OR

0.34, 95% CI 0.14-0.81). Within the logistic regression model, significant relationships were found between FVC and a respondent's sex ($p=0.04$), perceived eating habits ($p<0.001$), and highest level of household educational attainment ($p=0.02$).

Discussion. Significant relationships between FVC and food literacy were evident in food skills that were multifaceted, requiring that adolescents have the ability to perform a number of basic food skills and reflective of several food literacy attributes. The relationships found between multifaceted food skills and adolescent FVC suggest that food literacy attributes are interconnected and have reciprocal relationships.

Conclusion. Dietary behaviours are influenced by multiple factors. Study findings suggest that higher levels of adolescent food literacy, as reflected in multifaceted food skills, have the potential to positively impact their FVC. However, when societal factors are controlled for, food skills were not found to have a significant relationship with adolescent FVC, suggesting that factors outside of the control of the individual have the potential to minimize the influence of individual food literacy characteristics on adolescent FVC. Future food literacy programs should be inclusive of adolescents from all SES and should aim to teach and evaluate food literacy attributes that build more complex food skills.

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Glossary

Aboriginal Person. As defined within the Canadian Community Health Survey, "Aboriginal people are usually those with ancestors who resided in North America prior to European contact and who identify with one of the three Aboriginal groups listed on the questionnaire: First Nations (North American Indian), Métis and Inuk." (Statistics Canada, 2013c, p.73). Although, the term "Indigenous" is increasingly replacing the term "Aboriginal", this study uses the language as described in the survey data set, "Aboriginal", when referring to Indigenous survey respondents.

Adolescence. Adolescence refers to youth in the transitional period between puberty and adulthood, characterized by increased autonomy and independent decision making (Brooks & Begley, 2014; Smetana et al., 2004; Vaitkeviciute et al., 2014; Wray-Lake et al., 2010).

Body Mass Index. "Body mass index (BMI) is a person's weight in kilograms divided by the square of height in meters. A high BMI can be an indicator of high body fatness" (Center for Communicable Disease and Prevention [CDC], 2020).

Diet. The "habitually taken food and drink" (Diet, n.d).

Food Culture. Culture is defined as "the set of shared attitudes, values, goals, and practices that characterizes an institution or organization" (Culture, n.d). Food culture refers to the shared attitudes, values, goals, and practices surrounding the production and consumption of food.

Food Literacy. Vidgen and Gallegos (2014) define food literacy as:

> the scaffolding that empowers individuals, households, communities or nations to protect diet quality through change and strengthen dietary resilience over time. It is composed of a collection of inter-related knowledge, skills and behaviours required to plan, manage, select, prepare and eat food to meet needs and determine intake (p. 54).

Food Skills. "The knowing how, or the techniques of food purchasing, preparation, handling, and storage" (Azevedo et al., 2017, p. 2409).

Health Literacy. "The degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions" (Ratzan & Parker, 2002, p.vi).

Nutritional Knowledge. Nutritional knowledge "broadly defined, refers to knowledge of concepts and processes related to nutrition and health including knowledge of diet and health, diet and disease, foods representing major sources of nutrients, and dietary guidelines and recommendations" (Miller & Cassady, 2015, p.209).

Nutritional Transition. Nutritional transition is defined as, "the changes in dietary patterns and nutrient intakes when populations adopt modern lifestyles during economic and social development, urbanization and acculturation" (Vandevijvere et al., 2013, p. 135).

Obesogenic Food Environments. Obesogenic food environments are those food environments that contribute to behaviours associated with obesity, and often include fast food outlets and convenience stores, in addition to advertisements and in-store food promotions at supermarkets for ready-to-eat food products (Timmermans et al., 2018).

Self-Efficacy. Self-efficacy "examines the construct related to health behaviour's; the efficacy or capacity of performance in settings or situations, including overcoming obstacles to participate in an exercise" (Thomas et al., 2019, p.564).

Social Determinants of Health. The social determinants of health are "the social and economic factors that influence people's health" (Canadian Public Health Association [CPHA], 2021).

Abbreviations

BMI – Body Mass Index

CCHS – Canadian Community Health Survey

FS2 - Rapid Response on Food Skills (Part 2)–Mechanical Skills and Food Conceptualization

CPHA – Canadian Public Health Association

FVC – Fruit and Vegetable Consumption

FVCGTOT- Total Daily Fruit and Vegetable Consumption

SDH – Social Determinants of Health

SES – Socio-Economic Status

WHO – World Health Organization

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How Does Food Literacy Affect Fruit and Vegetable Consumption Among Canadian Adolescents?

Chapter One – Introduction and Background

Adolescents are losing the opportunity to observe and practice food skills as diets are shifting from home prepared meals made from basic ingredients to a diet comprised of ultra-processed foods, which require little food preparation skills (Monteiro et al., 2016; Slater & Mudryj, 2016**).** Changing food practices within the home setting has resulted in less time spent on food-related activities, thereby reducing the opportunity for adolescents to acquire important food preparation skills (Nelson et al., 2013; Slater & Mudryj, 2016). These dietary shifts have contributed to a general 'de-skilling' with respect to food choices and the preparation and consumption of foods associated with a healthy diet. (Caraher and Lang, 1999, p.9; Jaffe and Gertler, 2006, p. 143, 157-158; Slater & Mudryj, 2016, p. 113). Adolescent's declining ability to perform food skills increases their reliance on low-quality ultra-processed foods and has been linked to reduced consumption of minimally processed foods, such as fruits and vegetables (Caraher and Lang, 1999; Chu, et al., 2012).

The low-quality nature of ultra-processed food contributes to the rising occurrence of chronic disease attributed to poor diet quality (Crino et al., 2015; Djupegot et al., 2017; Holman & White, 2011; IDRC, 2011; Lam & Adams, 2017; Monteiro et al., 2013; Nagle et al., 2015; Poirier et al., 2019; Whiteman & Wilson, 2016; World Health Organization [WHO], 2002). The development of individual food skills that enable meals to be prepared from minimally processed foods, such as fruits and vegetables, may improve dietary habits. Thereby, focusing on the development of food skills could result in a diminished reliance on ultra-processed foods, potentially reducing an individual's risk of chronic disease attributed to low quality diet.

Evidence suggests that engaging in food preparation during adolescence is associated with ongoing healthy dietary behaviours and food preparation practices into adulthood, thus developing food preparation skills in adolescence may help better support individuals to make health informed food choices, limiting their consumption of ultra-processed foods, and thereby improving population health (Brooks & Begley, 2014; Laska et al., 2011; Vaitkevicicute et al., 2014).

Evidence suggests that food literacy helps to shape adolescent eating behaviour (Vaitkevicicute et al., 2014). Food decisions and dietary behaviours are complex interactions and can best be understood through the lens of food literacy. Food literacy has emerged as a concept derived from the principles of health literacy that link nutritional knowledge, food skills and diet behaviours. These attributes have been found to positively impact dietary behaviours (Colatruglio & Slater, 2016; Fernandez et al., 2020), and as such, initiatives aimed at improving population health have increasingly focused on developing food literacy (Colatruglio & Slater, 2016).

Nutritional knowledge and food skills acquired earlier in childhood influence the development of the adolescent's self-efficacy related to food choice, with skills mastery supporting food preparation confidence. Adolescence refers to youth in the transitional period between puberty and adulthood, characterized by increased autonomy and independent decision making (Brooks & Begley, 2014; Smetana et al., 2004; Vaitkeviciute et al., 2014; Wray-Lake et al., 2010). With an increase in autonomous decision making and freedom of movement away from the household, exploring food literacy in adolescents can aid in understanding the impact and predictive qualities of the facets of food literacy.

This study will examine how the facets of food literacy influence fruit and vegetable consumption (FVC) among Canadian adolescents. To critique the complexity of food literacy

applied to food knowledge, skills, and dietary decision making, the following discussion examines the impact that a transition to an ultra-processed diet has had on adolescent food literacy, defines the concept of food literacy, and introduces the food literacy framework which guides this study's investigation.

Nutritional Transition

A number of factors contribute to the issue of increased consumption of ultra-processed foods, and the resulting loss of food literacy in adolescents. One such factor is described as nutritional transition, "the changes in dietary patterns and nutrient intakes when populations adopt modern lifestyles during economic and social development, urbanization and acculturation" (Vandevijvere et al., 2013, p. 135). Nutritional transition occurs as populations move to urban centers, where they become distanced from their food sources, and acculturated to the most accessible and convenient food systems (Monteiro et al., 2016). The resulting dominant food culture emerging from nutritional transition has become one dominated by packaged, ready to consume products (Monteiro et al., 2016, p.29). Between 1938 and 2001, Canadian's have increasingly purchased ultra-processed foods comparative to "unprocessed or minimally processed foods and processed culinary ingredients" (Moubarac et al., 2017, p. 514). The reliance on low-quality ultra-processed foods as a main component of daily dietary intake is evident within the Canadian population, where in 2004 ultra-processed foods represented just under half (47.7%) of daily dietary intake (Moubarac et al., 2017). Reducing the intake of ultra-processed foods and increasing the consumption of meals made from unprocessed or minimally processed foods is recommended to improve diet quality (Moubarac et al., 2017, p. 512).

To reduce the intake of ultra-processed foods and subsequently increase the intake of unprocessed or minimally processed foods, it is beneficial to understand what foods fall within

each of these categories, and the thereby better understand the food skills required for preparation of these foods. The term ultra-processed food is derived from the NOVA food classification (Table 1). NOVA is an internationally recognized tool that categorises food according to the extent and purpose of food processing, rather than in terms of nutrients (Monteiro et al., 2016). Fruit and vegetable consumption, as indicated in Group one, is described as a natural food and a healthier option, with no additives. As such, FVC is a reasonable variable to examine for evidence that an adolescent is making a healthy food choice.

Table 1

Summary of the NOVA Food Classification Categories

NOVA Food Classification Categories				
	Group 1	**Group 2**	**Group 3**	**Group 4**
	Unprocessed food	Processed culinary ingredients	Processed foods made from simple ingredients	Ultra-processed food and drink
Description of food contents	• Natural foods that have been minimally processed through the removal of unwanted parts, drying, crushing, grinding, boiling, roasting, or freezing. • Foods which have had nothing added to them.	• Obtained directly from Group 1 foods or by natural process such as grinding, milling, or pressing. • Used to make products to prepare, season, and cook Group 1 foods-	• Foods made by adding group 1 and group 2 foods together. • Typically contain two or three ingredients.	• Contains industrial formulations. • May contain five or more ingredients. • May include substances not found in culinary preparation. • Minimal to no Group 1 foods. • Products from Groups 1 and 3 that contain cosmetic or sensory intensifying ingredients.
Examples	The edible parts of plants, fungi, water, and of animals after separation from nature. Minimally processed foods.	Salt, sugar, molasses, honey, vegetable oils, and butter. Starches such as corn.	Cheese, smoked meats, and freshly made bread.	Stabilizers, preservatives, and dyes. Pasties, cereal, pre-prepared, pasta, pizza, hot dogs, flavored yogurt, and emulsifiers added to breads.

Note. Adapted from "NOVA. The star shines bright. [Food classification. Public Health]" by C.A. Monterio, et al., 2016, *World Health, 7*(1-3), 29-38.

As a high-quality food choice, fruits and vegetables can require a level of food preparation to be included in a meal made from simple ingredients (NOVA Group three) or prepared and stored for future use. Preparation of unprocessed foods or minimally processed foods requires both knowledge and skill, since the individual needs to be aware of the nutritional value of the food as well as the ways in which to prepare, cook, and store unprocessed food to retain nutritional value and maintain food safety. While the shift towards increased consumption of ultra-processed foods (NOVA Group four) has been thought to erode food skills, the development of food skills enables an individual to prepare food from basic ingredients, which has been linked to lower consumption of ultra-processed foods (Lam & Adams, 2017).

Food Literacy

The use of the phrase "food literacy" has increased rapidly since first introduced, with the phrase being defined 39 times and cited more than 1049 times in the academic and gray literature between 2001 and 2016 (Truman et al., 2017). The term food literacy first emerged in 2001 in a study by Kolasa et al. (2001) that aimed to increase food and nutritional knowledge of adults with a low-income (Truman et al., 2017) through the application of health literacy concepts to food and nutrition. Since the concept of food literacy was first introduced, it has evolved "as a term to describe the everyday practicalities associated with healthy eating" (Vidgen & Gallegos, 2014, p.50). The concept is also noted across a diverse range of literature as a perspective from which to explore the many factors, knowledge, skills, and behaviours linked to food (Azevedo Perry et al. 2017; Truman et al., 2017; Vidgen & Gallegos, 2014). The generality of the description of food literacy is vague and broad in its ability to guide the current study's investigation, as such it is necessary to further define food literacy. The current study will employ the frequently cited

food literacy definition by Vidgen and Gallegos (2014), which captures the emerging perspectives, and defines food literacy as:

> the scaffolding that empowers individuals, households, communities, or nations to protect diet quality through change and strengthen dietary resilience over time. It is composed of a collection of inter-related knowledge, skills and behaviours required to plan, manage, select, prepare and eat food to meet needs and determine intake (p.54).

Food literacy is a concept used to situate and further explore the complexity of both individual and social factors that influence and shape dietary patterns and behaviours at an individual, household, community, and wider social level. Organizing food literacy into a framework can aid in understanding the overlapping constructs that serve to inform this study.

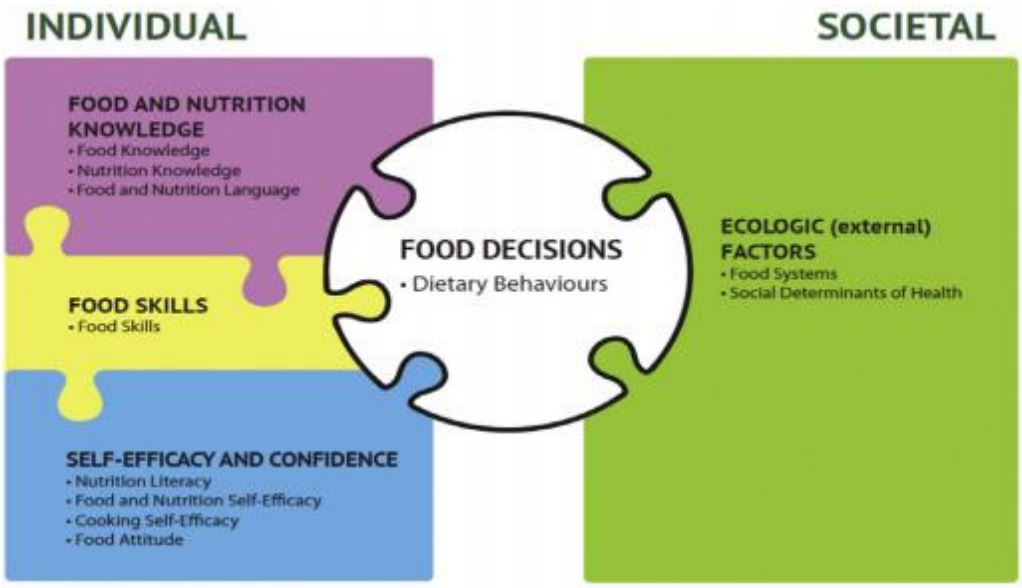
Food Literacy Framework

When evaluating study variables for attributes of food literacy, a framework is useful, as the aforementioned definition is broad in its ability to guide the selection of variables that align with the underlying concepts of food literacy. A scoping review by Azevedo Perry et al. (2017) identified attributes of food literacy, resulting in the development of a food literacy conceptual model, which has since been developed into a proposed food literacy framework (Figure 1) aimed at supporting the development of a food literacy measurement tool; a Locally Driven Collaborative Projects program, funded and supported by Public Health Ontario (Thomas et al., 2019). The food literacy framework identifies five categories: food and nutritional knowledge - "facts and information acquired through experience or education related to foods and nutrition"; food skills - "techniques of food purchasing, preparation, handling, storage"; self-efficacy and confidence - "examines the construct related to health behaviour's; the efficacy or capacity of performance in settings or situations, including overcoming obstacles to participate in an

exercise"; societal/ ecologic - "meso- and macrosystem that interact with food decisions and practices"; and food decisions - "applying knowledge, information, skills to make healthy food choices" (Thomas et al., 2019, p. 564-566). Within the framework's five categories, 11 key attributes are identified to further define each category. The framework appears visually as a puzzle, where food skills are linked to food and nutritional knowledge, self-efficacy and confidence, and food decisions, which are all ultimately influenced by ecological factors. These interdependent concepts related to the many facets of food literacy influence dietary practices and are easily identifiable within the framework. To examine food skills among Canadian adolescents and their relationship to FVC, all pieces of the puzzle must be considered.

Figure 1

Food Literacy Framework



Note. Reprinted from "Complexities in conceptualizing and measuring food literacy" by H. Thomas et al., 2019, *Journal of the Academy of Nutrition and Dietetics, 119*(4), p. 570. Copyright License Number 4986850126470. Copyright certificate in Appendix A.

Relationships Between Food Literacy Categories

Although the Thomas et al. (2019) food literacy framework places food literacy attributes into categories, the authors note that the attributes operate in an interdependent manner (Azevedo Perry et al., 2017; Thomas et al., 2019) and as such should not be evaluated completely independent of each other. For example, nutritional knowledge creates the conditions for change (Vaitkeviciute et al., 2014), but when isolated does not generate desirable dietary behaviour without self-efficacy and food skills (Carbone & Zoellner, 2012; Guntzviller et al., 2017; Taggart et al., 2012). While an individual may know that one should eat well, what a healthy diet encompasses, and how to read nutritional labels, their ability to act on this knowledge may be impacted by their ability to perform the necessary food skills to prepare healthy meals. Food skills, beyond simple technical skills such as chopping, mixing, stirring, and measuring of ingredients, include the ability to read recipes and plan meals (Lam & Adams, 2017), and have been associated with higher self-efficacy related to an individual's ability to prepare foods from basic ingredients (Azevedo et al., 2017; Bailey et al., 2019). However, although self-efficacy can aid in an individual's desire to develop and perform food skills, self-efficacy alone is not enough to change dietary behaviours. Despite an individual's belief that they can execute healthy food choices, they must also have behavioural capacity and health literacy to perform the desired change (Guntzviller et al., 2017). Thus, the individual puzzle pieces of food literacy are interconnected and together influence diet decisions.

Dietary behaviours are further impacted by the availability of healthy foods, which are often impacted by extrinsic or social, cultural, and political environments that are beyond the immediate control of the individual, nonmodifiable factors (Velardo, 2015, p. 386-388). Although food skills may frame the way people consume food, the "availability of foods

determine in part the type and range of cooking to be applied" (Caraher & Lang, 1999, p.9). For example, an individual may know that eating fruits and vegetables are part of a healthy diet and have the food skills to prepare meals containing fruits and vegetables, however, may not have access to fruits and vegetables due to income. Barriers to accessing healthy foods extend beyond income. Food culture represents one such modifiable barrier that can be attributed to nutritional transition within a home and thereby the food learning environment. Thus, an individual with the economic resources to access healthy food may not possess the nutritional knowledge or food preparation skills required to prepare foods that are minimally processed, and as such may not provide for such foods within the home setting. Societal factors, both nonmodifiable and modifiable, influence dietary behaviours through access to healthy food options.

When examining food skills and adolescent diet decisions through the lens of food literacy, the development of food skills is interconnected with nutritional knowledge and self-efficacy, in addition to societal/ external attributes linked to nonmodifiable factors such as the social processes that exist around eating behaviors, food access, (Vidgen & Gallegos, 2014), and a changing food environment. The Thomas et al. (2019) food literacy framework offers a format to examine the complex interconnections between the food literacy categories and or factors that influence diet decisions, such as FVC among adolescents.

Chapter 2: Literature Review

A literature review was conducted to determine the current understanding of adolescent food literacy and its relationship to dietary behaviours. The review methodology was informed by the five stages of the Arksy and O'Malley's (2005) methodology framework. The literature review methodology, results, strengths and limitations, and conclusion will be discussed in the following chapter.

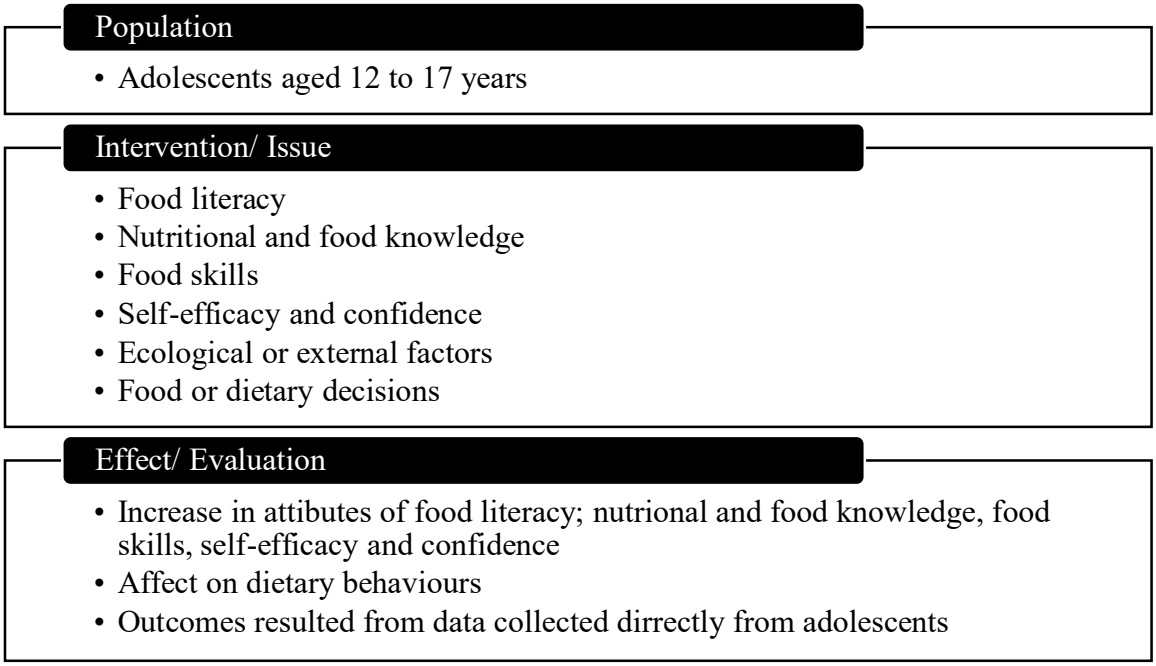
Literature Search Methodology

This review was guided by the question – what is the relationship between adolescent food literacy and dietary behaviour? The Population, Intervention, Effect (PIE) search strategy was used to identify key search terms, Figure 2 (Hoffman et al., 2017). The population of focus was healthy adolescents aged 12 through 17 years, however studies involving individuals outside of these ranges were included if the study included the population of interest. Interventions were considered if they focused the various categories and attributes encompassed in the concept of food literacy, as outlined by Thomas et al. (2019) food literacy framework (Figure 2).

Three databases were searched May 02, 2018: Cumulative Index to Nursing and Allied Health Literature (CINAHL) Elton B. Stephens Company host (EBSCO), PubMed Medline, and Science Direct. The database selection was based on the data base focus, nursing, medicine, and health care. To account for a time lapse in review analysis, the search was updated on November 01, 2020, using the search criteria outlined for the original search. Narrative descriptions of electronic searches used in each database are outlined in Appendix B. The study selection reporting method was based on the preferred reporting items for systematic reviews and meta-analyses (PRISMA) extension for scoping reviews (Figure 3) (Tricco et al., 2018).

Figure 2

Population, Intervention, Effect (PIE) Formulated Question. "What is the Relationship Between Adolescent Food Literacy and Dietary Behaviours?"

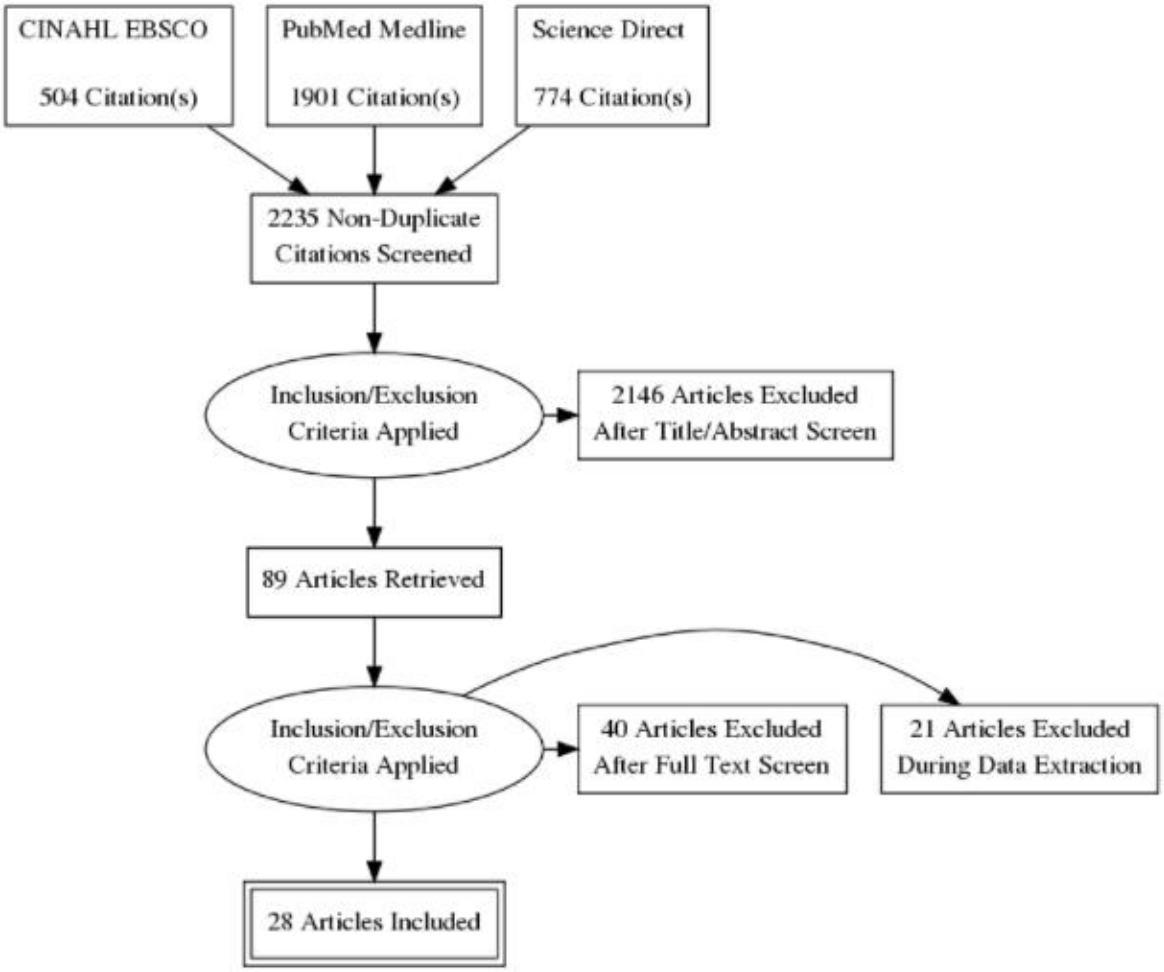


Note. Figure 2, PIE formulated question based on "Evidence-based practice across the health professions (3rd ed.)" by T. Hoffman et al., 2017, Elsevier.

Only English language, peer-reviewed articles which included data collected directly from adolescents aged 12 through 17 years were included. Studies were excluded if they focused on specific populations instead of a generalized population. Excluded study sample populations included populations whose food behaviours were potentially impacted by significant food security concerns, and populations who are identified as undernourished, overweight, medically ill, or as having pre-existing conditions. As well, specific populations such as athletes, or studies focused on a pregnant population were excluded. An expansive list of the inclusion and exclusion criteria is included in Appendix C.

Figure 3

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Model of Literature Searches, Search Dates No-Date - November 01, 2020.



Note. Search model based on "PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation" by A.C. Tricco, et al., 2018, *Annals of Internal Medicine, 169*(7), 467.

Results

The search resulted in 2,235 articles after duplicates were removed. Following application of the inclusion and exclusion criteria to the title and abstract screen, 89 articles were retrieved for full text review. Following full text review, 49 articles were included in the final analysis, 21

articles were excluded during data extraction, resulting in 28 articles being included in the literature review.

A literature matrix was created to chart key elements from the data; categories included authors and publication date, study purpose, study design, sample characteristics including age, sex, country of origin, and sampling methods, key findings, and food literacy characteristics. Table 2 provides a summary of the included studies and key findings.

Table 2

Summary of Studies Included in Current Literature Review of the Relationship Between Adolescent Food Literacy and Dietary Behaviours (N=28).

Author/ Year	Purpose	Study Design	Participant Characteristics	Key Findings
Bailey et al., 2019.	"To synthesise the literature on food literacy interventions among adolescents in secondary schools, the attitudes, and perceptions of food literacy interventions in secondary schools, and their effects on dietary outcomes" (p.2891).	Systematic review	**Sample**: 44 studies **Age:** Studies with subjects aged 10-19 years of age. **Country**: of review, Australia	Food literacy programs were found to improved cooking skills, food safety knowledge, food knowledge, and short term healthy dietary behaviours. Four of five studies on school garden programs had a positive effect on FVC. Eight of nine studies found positive effect of food knowledge programs on dietary behaviours. Six studies evaluated cooking and food safety programs, results demonstrated improved cooking skills, willingness to taste new foods, nutritional knowledge, self-efficacy, and FVC. Adolescent attitudes were generally found to be positive towards cooking programs in school. Limited opportunities to develop food skills was identified as a barrier to healthy eating. A longitudinal study suggested that food skills and behaviours learned in adolescents were sustained later in life. **Sex**: "Four studies revealed that females have greater nutritional knowledge than males." One study identified that although both boys and girls had a reasonable level of nutritional knowledge, only boys had good nutritional practices" (2908).
Bau et al., 2011.	"Was to investigate the impact of social living conditions and girl's and/or parents' weight status on food frequency, meal context and daily portion sizes among adolescent girls" (p.1764).	Secondary analysis of the cross-sectional study, Berlin School Children's Cohort.	**Sample**: 1519 and parents **Sex**: 100 % female **Age**: 11-14 years **Country**: Germany **Sampling method**: Random, from 69 East Berlin schools. Selected from the 2006-2007 Berlin School Children's Cohort Study	Low family SES was associated with lower adolescent FVC compared to higher family SES. Two parent homes were associated with higher adolescent FVC compared to single parent homes. **Sex**: Lower mothers' education was associated negatively to adolescent eating behaviour. Higher BMI of mothers was associated with poor adolescent eating behaviour compared to mothers with healthy BMI. No link was found between father's educational or fathers' weight and the study participants' weight and eating behaviour.
Brooks & Begley, 2014.	"The aim of this study was to explore what is known about food literacy programmes targeting adolescents, including identification of the constituents of food literacy addressed, assessment of programme effectiveness, and description of programme design or delivery specific to adolescents" (p.158).	A review of the peer-reviewed literature	**Sample**: 23 studies included, 19 peer-reviewed papers and 4 grey literature food literacy. **Age:** 13-17. **Country**: of review, Australia	Nineteen studies reported positive changes related to the intervention, however "these did not include significant changes in diet quality or cooking frequency at home" (p.158). Programs that were successful in increasing FVC involved interventions focused on cooking skills, some in combination with nutritional knowledge. Key factors affecting adolescent FVC included availability of unhealthy options in the school and home settings, the perception that health food is expensive and peer influence. Adolescents placed value on family meals.
Chartatos et al., 2018	"This study aimed to gain a better understanding of the consumption habits of adolescents in the school arena by comparing different personal characteristics and	"A convergent mixed methods design collected qualitative and quantitative data in parallel.	**Sample:** Quantitative n=742; qualitative n=55 **Age:** Quantitative - 12-13 years and Focus groups 12-14 years; overall mean 13.6years	Students who never used the school canteen had a high self-efficacy score (52%) ($p<.001$) and came from parents with a high education (65.5%) ($p<0.001$), compared to those who used it often ($\geq$ 3 times a week). Students who often used the school canteen had higher consumption of salty snacks ($p<0.03$, 21.7% vs 11.5% never), baked sweets ($p=0.007$, 19.6% vs 9.3% never), and soft drinks ($p=0.002$, 19.6% vs 7.9% never). Students who often used the

	purchasing behaviours of infrequent and regular school canteen users to those never or seldom using the canteen" (p.1).	A cross-sectional quantitative study" (p.1)	**Sex:** Quantitative - female = 53%; Focus groups - 29 females and 26 males, 53% female **Country:** Norway **Sampling method:** Quantitative – all students in the 8th grade from 11 secondary schools. Qualitative – Staff, plus 2 9th grade students from 6/ 11 participating secondary schools.	school canteen had "higher odds of purchasing food/drink from shops near school during school breaks and before/after school compared to the never group (adjusted odds ratio (OR) = 1.80, 95% CI 1.07–3.01, and OR = 3.61, 95% CI 2.17–6.01, respectively)" (p.1). Often use of school canteen was not statistically significant for FVC (p=0.40 and 0.16). **Sex:** Females represented a significantly higher proportion of students who never used the school canteen (57.1%) (p=0.03).
Do Amaral e Melo et al., 2020	To conduct a "review of studies investigating the association of [frequency of family meals] FFM with [nutritional status] NS and/or [food consumption] FC in adolescents aged 10 to 19 years" (p.2).	Systematic review	**Sample:** 50 studies **Age:** 10-19, but "studies involving older children or young adults in addition to adolescents were also considered eligible for inclusion" (3). **Country:** of review, Brazil	Increased frequency of family meals was associated with healthier adolescent weight, increased consumption of healthy foods (FVC, whole grains, beans, dairy) and declining consumption of unhealthy foods (soft drinks, fried foods, fast food). Food culture was underexplored, including food customs, and eating practices as well as location of meal. No consensus was found regarding the ideal number of family meals, location, type of meal, and other meal patterns.
Fleary et al., 2018.	"To systematically review and synthesis the literature on the relationship between health literacy and health behaviours in adolescents" (p. 116).	Systematic Review	**Sample:** 17 studies **Age**: 10 to 23 years **Country**: of review, USA	"Results suggest that there is a meaningful relationship between health literacy and adolescents' health behavior" (p. 116). Results found that the relationship between parental education, income, and adolescent health literacy was consistent across the studies. Adolescents from homes with higher parental education and income were more likely to have a higher health literacy compared to those from homes with lower parental education. Higher health literacy in adolescents was associated with higher health promoting behaviours. **Sex**: "Of the thirteen studies examining sex, nine found no relationship between sex and health literacy, one found a positive relationship for boys, and three found a positive relationship for girls" (119).
Garrido-Fernández et al., 2020	"The objective of this study is to identify the relationship between students' eating habits during the school day and sociodemographic, family and physical activity variables, as well as the existence of a school cafeteria" (p.1)	Cross-sectional, exploratory study.	**Sample:** 8068 **Sex:** 50.9 %male, 49.1% female **Age:** Mean age=15.71years (SD=3.65) **Country:** Spain **Sampling Method:** stratified random sample, public high school students. multistage sample stratified by clusters	The presence of a cafeteria increases the probability of not having breakfast at home (OR:1.23), as did not regularly performing physical activity (OR:1.46) (p<0.005). The results show that students who are 14 years old are more likely to skip breakfast at home (p<0.001) than those 12 and 13 years of age. Students whose mothers do not have a university education (OR:1.83), and whose both parents do not have a university education (OR:4:48) are more likely to consume incomplete breakfasts. Snacks with sweets (OR:1.93), candy (OR:2.75), and bagged crisps (OR:3.06) were more likely to be consumed in schools with a cafeteria. **Sex:** Females were more likely to consume bagged crisps (OR: 1.36) and candy (OR:1.48) during the school day than males. Females skipped breakfast more than males (p<0.001).
Ghasab et al., 2017.	"The present study is set to recognize determinant factors for teenagers' nutritional behaviours based on social-ecological model" (p.1).	Literature review	**Sample**: not reported **Age:** 10-19 years. **Country:** of review, Iran	Emotional eating was common in teenagers. Food preferences were often established in childhood. Teens often have high nutritional awareness; however, their behaviour does not always match this awareness. Mothers' education level and household income were positively associated with higher health behaviours. Factors impacting nutritional behaviours included the availability of food in home, diet restrictions applied by parents, peer influence, school rules, social norms, food centers, media and organizational, community and public policy determinant. **Sex:** Girls had higher FVC and nutritional knowledge than boys, however, had more unhealthy nutritional behaviours, including skipping breakfast.

Gracey et al., 1996.	To "measure knowledge about nutrition and beliefs, behaviours, and possible barriers affecting healthy food choices in adolescents". The findings were examined in relation to eating habits and other lifestyle factors. (p. 189)	Cross-sectional	**Sample:** 391 **Sex**: 47% male **Age:** 15-16 years, mean 15.8 years \ **Country:** Australia **Sampling method:** All students in __ year from 3 randomly selected schools from a list of higher and lower SES schools as classified by the Australian bureau of statistics, 2 public and 1 private school, from mainstream English-speaking programs.	Higher nutritional knowledge was associated with a higher variety of foods consumed compared to those with lower nutritional knowledge. Healthy eating declined in relation to higher alcohol and TV consumption. Adolescents who drank alcohol or smoked cigarettes had higher fat intake compared to those who did not. Healthy eating improved in relation to higher self-efficacy scores, nutritional knowledge scores, considerations for weight control and well-being, and influence over foods in the home. Barriers to healthy eating included suitable foods within the home and school, inability to influence food choices at home, and nutritional knowledge deficits related to fats. **Sex:** Males had lower self-efficacy related to health behaviours compared to girls, no variance when SES was controlled. Females ranked health beliefs and values as more important compared to males. Females ranked barriers to change higher than males. Food variety scores and female consumption of breakfast were lower in low SES schools, compared to high SES schools.
Hanson et al., 2004	"Examines parental report of household food availability, parent dietary intake and associations with adolescent intakes of fruits, vegetables and dairy foods" (p. 77).	Cross- sectional	**Sample**: 902 students and 902 parents, n=1804 **Sex:** Students - 424 males and 478 females, parents - targeted mothers) - 810 females and 92 males **Age:** Adolescent (no age stated) **Country:** USA **Sampling Method:** Public middle and senior schools in Minnesota, USA, 1998-1999.Sample was taken from a larger Project EAT study of 4746 participants.	90.3% of parents report that fruits and vegetables are available in the home. 87% serve vegetables at dinner. 66.6% serve dairy at dinner. 56.8% had soft drinks available in home. Availability of soft dinks in home was associated with declined dairy intake. No significant correlations were found between serving vegetables at supper and adolescent vegetable consumption. **Sex:** Higher household availability of fruits and vegetables was associated with increased FVC in female adolescents. Higher parental intake of dairy was associated with higher dairy intake in adolescent males. Higher parental intake of dairy, vegetables, and fruit was positively associated with higher female adolescent intake of these foods.
Lai Yeung, 2010.	"To investigate the eating attitudes and behaviours of junior secondary students in Hong Kong, with specific focus on gender differences" (p.250).	Cross-sectional; cross-tabulation analyses	**Sample:** n=836 **Sex:** 469 females, 309 males. **Age:** Between 11 and 18 years **Country:** Hong Kong **Sampling Method:** Random sample from 33 different secondary school students in Hong Kong.	No significant difference was observed between respondents' eating habits and levels of nutritional knowledge. Adolescents chose food based on sensory appeal and immediate food enjoyment over concern for long term health. The impact of peer influence was minimal. 54% of respondents did not eat breakfast and one tenth ate the recommended daily fruit and vegetable intake. 67% of respondents believed they had adequate food knowledge. More than two-thirds of the respondents gave correct answers to the questions in the food knowledge quiz. **Sex:** "More female students believed that their friends care about eating healthful food (62% vs 53%), and more male students believed that their friends care very much about staying fit and exercising than the female students (66% vs 58%)" (p.252).
Lake et al., 2004.	"A longitudinal dietary survey study provided quantitative evidence of dietary change and investigated factors influencing dietary change from adolescence to adulthood, using sociodemographic data and participants' own perceptions of, and attributions for, their dietary change" (p. 255).	Cross-sectional – Perspective cohort study	**Sample:** n=198 **Sex:** 81 Male and 117 Female participants at the 20-year data collection. **Age:** 1980 mean age was 11.6 years and 2000 mean age was 32.5. **Country:** United Kingdom **Sampling Method:** n=405, 7th and 9th graders, selected from 7 schools in 1980.	Most respondents believed that their diets became healthier over the last 20 years. Respondents believed that the increased attention given to diet and health by the media since the 1980's had resulted in an increased awareness of nutrition and health positively impacting their diet choice. Participants who believed that their parents had a positive impact on their diet had higher FVC in adolescents. Those who felt their parents were a negative influence on their diet had more than twice (17% increase) the increase in FVC as compared to those who felt their parents had a positive influence (7%) over the 20 years. Employment was cited as a reason for "time famine"; respondents who cited a "time famine" had smaller increases in FVC over 20 years.

				Sex: Mothers' purchasing habits were influenced by what their 'children would eat' and family preferences. Parent's diet growing up influenced dietary behaviour in 47% of females, compared to 38% of males. Having children influenced the diets of females by 49%, compared to 38% of males. Partners influence dietary behaviours of males by 62%, compared to 59% of females.
Mokhtari et al., 2017.	"Effect of educational intervention program for parents on adolescents' nutritional behaviors in Isfahan in 2016" (p.1).	"Two-group semi-experimental study" (3).	**Sample:** n=63 students and unreported parent n **Sex:** 100% female and unreported parent gender. **Age:** μ=13.39 years of female student; father μ=43.24 years; mother μ=38.15 years. **Country:** Iran **Sampling Method:** Random sample of volunteers from the 7th, 8th and 9th grade from 4 randomly drawn schools, from 2 education districts. Participants were divided into a control group and an intervention group.	Parents received weekly nutritional education and girls completed food frequency and behaviour questionnaire to evaluate the impact of the parental education. "No significant difference was in the nutritional behaviors before and after the intervention. Hence, just educating the parents is not enough for achieving appropriate nutritional behaviors in the adolescents" (p.2).
Nagy-Pénzea et al., 2020	"Whether better health-related knowledge is correlated with favorable health behavior in adolescents is an important, still unanswered question. Our objective was to examine this relationship" (p.1).	Cross-sectional, exploratory study.	**Sample:** n=259 **Sex:** Male - 49.6%; female - 50.4% **Age:** Mean age=14.9years, 14-16 years. **Country:** Hungary **Sampling Method:** All grade 9 students in Hajdú-Bihar County, over two academic years (2016-2017 and 2017-2018) were invited to voluntary participate.	Adolescents with mothers who had a higher education, compared to mothers with lower education, had lower likelihood of consuming sweets (p=0.019) and soft drinks (p=0.029). There was no statistically significant relationship found between higher nutritional knowledge and a healthier diet. A higher fathers' education compared to lower education, and higher family affluence compared to lower affluence, was associated with higher nutritional knowledge. Increasing age was negatively associated with nutritional knowledge, however since only grade 9 students were accessed, the older students may represent those held back a grade or who started school later, and therefore cannot be generalized. **Sex:** Females had a higher nutritional knowledge compared to males (p=0.008). Females had lower regular consumption of breakfast as compared to males (p=0.027).
Orehek & Ferrer, 2018.	"This research leverages theory on goal pursuit within relationships to investigate whether parents are instrumental to adolescents' eating and activity."	"Correlational" (11), FLASHE was a cross-sectional study.	**Sample**: n= 1556 parent and adolescent dyads; n=3112 **Sex:** 50% of adolescents were female, and 75% of parent participants were female. **Age:** Adolescent μ age was 14.45 years, parent μ age was 43.66 years. **Country:** USA **Sampling Method**: Study used data collected in the National Cancer Institute's Family Life, Activity, Sun, Health, and Eating study (FLASHE). Participants to FLASHE were recruited Ipsos Customer Opinion Panel, using sample balancing methods.	"Greater adolescent-perceived parent instrumentality was associated with greater [FVC] and physical activity, and lower sedentariness" (p.1). Parent-perceived parent instrumentality was associated with greater adolescent FVC, less hedonic eating, and more activity. Adolescent BMI was partially associated to parent instrumentality for activity. Sedentariness for both parent and adolescent was associated with higher BMI. Parents' FVC and hedonic eating was associated with parental BMI, but not adolescent. Adolescent BMI was associated with adolescent activity.

Park et al., 2013.	To examine "the association between school and neighborhood nutrition environment and adolescent nutritional behaviour and weight status" (p.655).	Cross-sectional	**Sample:** n=939, **Sex:** 49.7% of participants were female **Age:** μ age 12.1 years **Country:** South Korea **Sampling Method:** Random selection from 15 schools in 8 school districts in Seoul; cluster-sampling method	High-density supermarkets and traditional markets in school and home neighborhoods was associated with greater likelihood of adolescent obesity. The effect of high-density supermarkets in home neighborhoods was neutralized with increasing household SES. School nutrition environment was not associated with student eating habits or weight status. Fifteen percent of adolescents skipped breakfast, increasing as adolescents aged. Healthy eating scores declined with age. **Sex:** Younger, female students who came from more affluent families, with less screen time, or had a stay-at-home mother, had higher scores in the healthy eating index. Females had higher fruit consumption and had higher healthy eating scores compared to males. Females who lived in high-density food market neighborhoods were 58% more likely to be obese than those in less dense neighborhoods. The employment status of the mother neutralized the neighborhood effects on healthy eating for females. Lower neighbourhood SES was associated with increased likelihood of male obesity compared to higher neighborhood SES.
Pearson et al., 2009.	"The aim of this study was to examine the association between indicators of family circumstance and adolescent dietary behaviour and change in dietary behaviour" (p.671).	"Cross-sectionally and prospectively 2 years later" (p.669)	**Sample:** n=3264 students completed the 2 year follow up survey, representing 58% of original participants. **Sex:** At baseline, 55.5% of students were female; 84% of parents were female **Age:** Students - 12-15years, and parent - 36-50 years at baseline. **Country:** Australia **Sampling Method:** All year 7 and 9 students from participating schools in Melbourne Australia, in 2004-2005 were invited to participate in an online survey, and a follow up survey in 2006/2007.	"A higher level of maternal education was associated with positive dietary behaviours among adolescent boys cross-sectionally and with positive dietary change among adolescent boys and girls longitudinally" (p. 673). **Sex:** Males from dual-parent homes were less likely to have low FVC longitudinally, compared to single parent homes. Females from dual-parent homes were less likely to snack and more likely to consume vegetables longitudinally, compared to single parent homes. Higher maternal employment was negatively related to female adolescent's diet. The influence of having a brother was negatively associated with diet, however, was associated with increased breakfast consumption in females.
Pitel et al., 2013.	"We investigated socioeconomic differences in health-related behaviors among Slovak adolescents and the potential modification of those differences by gender" (p.211).	Cross-sectional	**Sample:** n = 3547 **Sex:** 49.4% male **Age:** μ 14.3 years. **Country:** Slovakia **Sampling Method:** Students in the 8th and 9th grades of randomly selected elementary schools.	Higher household education was found to have minimal impact of adolescent health behaviour. **Sex:** Intake measured as 'no daily intake' for fruits and vegetables and skipping breakfast was more prevalent as socioeconomic class declined for females (95.2% of those with middle SES compared to 90.3% of those with high SES; odds ratio, 2.33).
Raber et al., 2018.	"This paper explores the ability of eButton image analysis to capture home food preparation behaviors/practices in a sample of pre- and early adolescent" (p.2).	"This is a secondary analysis of two eButton pilot projects" (p.1). "This study employed observational methods"(p.2).	**Sample:** n=31 **Sex**: 51.6% female **Age**: Study 1 - 8-13 years, study 2 - 9-13. **Country:** USA **Sampling Method**: Respondents to study advertisement through various mediums and from a volunteer data base.	The most common activity was browsing, pantry (51.6%) or fridge (71%). Less than half of the participants demonstrated food preparation skills beyond opening packages (41.9%) and combining 2 or more ingredients (45.2%); actual cutting and measuring of foods were rare (<12.9% each); and 22.6% used microwave for heat source. 51.6% witnessed food preparation by adults. Increasing adolescent age was associated with decreased browsing, increased food media usage, and increased food preparation and plating.
Ronto et al., 2016.	"This study explored adolescents' perspectives of the importance of food literacy on	Mixed methodology; quantitative	**Sample:** n= 131 **Sex:** 69.5% female **Age:** 12-17 years	Adolescents ranked food and nutritional knowledge as more important than food skills and food capacity. Most adolescents reported low confidence in food skills. Most felt it was important to follow national guidelines, however,

Australia	their dietary behaviours" (p.550).	data analysis using SPSSv22; Qualitative focus group (Theoretical saturation reached by group 7, however due to quantitative component 15 groups conducted).	**Country:** Australia **Sampling Method:** Sample was recruited via an introductory email to health education teachers from Southeast Queensland who had volunteered to participate in food literacy research, 3 schools agreed to participate, all students were invited to participate between 7th and 12th grade.	perceived that only those on strict diets should follow the guidelines and that the growing adolescent's body did not need to follow the guidelines. Most did not select food or prepare food according to guidelines, as they lacked knowledge on how to apply them. None of the aspects of food skills were ranked in the top 6 as most important in supporting them to eat healthy, these skills were viewed as something they would need in future when they had families. Adolescents felt they had limited opportunities to gain food skills. Most participants reported 'sort of' confidence in cooking, and mainly prepared simple dishes or prepackaged foods. Most participants did not understand that not all information on the internet was reliable. Most did not read food labels; main reasons being a lack of knowledge on what to look for and labels as to complicated. Participants felt a positive attitude towards healthy foods led to healthy food behaviours. **Sex:** Senior females rated portion size knowledge as more important than males, and males ranked 'knowing where their food comes from' as more important that females.
Sahingoz & Sanlier, 2011.	"This study was designed and conducted to determine the level of nutritional knowledge amongst adolescents living in Turkey…and to detect the extent to which their diet complies with the Mediterranean Diet Quality Index (KIDMED)" (p.272).	Not stated, but description is cross-sectional.	**Sample:** 890 **Sex:** 464 males and 426 females **Age**: 10–14 years. Country: Turkey **Sampling Method:** voluntary, from schools in Ankara	Nutrition knowledge levels were found to be associated with nutritional habits. KINMED scores were higher for those students who did not skip meals. As the number of meals increased, so did the KINMED score. As the mother's education level rose, the KINMED scores and nutritional knowledge score rose. **Sex:** No gender differences in nutritional knowledge, but there were differences in some question, such as girls scored higher in should consume fruits and vegetables and not consume food late at night, whereas boys scored higher on should enjoy eating and questions re meals being beneficial with meats.
Sanchez et al., 2007.	"The aims of the present study were to: (1) describe the prevalence and clustering patterns of four adolescent health behaviors (physical activity, TV viewing time, fruit and vegetable consumption, dietary fat intake); (2) examine the sociodemographic, behavioral and parent health behavior correlates of the number of health risk behaviors" (p.125).	Cross-sectional	**Sample:** 878 youth **Sex**: 413 female, 356 male, 53.6% female **Age**: 11-15 years, mean 12.7 years **Country**: USA **Sampling**: Convenience sample accessed through primary care provider, (6 clinics and 45 providers) in San Diego County.	Adolescents consumed 33% of daily calories from fat and roughly 3 servings of fruits and vegetables. 11.9% met recommended guidelines for fruits and vegetables. Risk factors were clustered: 3 risk factors (not meeting recommended physical activity, daily fat intake, and FVC) were prevalent in 25.3% of females and 14.2% of males; 2 risk behaviours (fat intake and FVC) were prevalent 12.4% in females and 25.4% in males; 1 risk behaviour (FVC) was prevalent 6.3% on females and 11.3 % in males. **Sex:** Number of risk factors in females increased with increasing age, being overweight, having a parent who smoked and consumed less than 5 fruits and vegetables per day. Increasing male age was associated with reduced risk factors. Normal weight in males was associated with increased risk factors. Increased parent risk behaviour was associated with increased male risk behaviours. Females who had 2 parents who never smoked and met fruit and vegetable guidelines had fewer risk factors.

Sichert-Hellert et al., 2011.	"To assess the overall degree of formal nutritional knowledge in adolescents across Europe. To examine potential sociodemographic determinants of nutritional knowledge such as gender, body weight status, immigrant status and parental education and financial level, using data from HELENA-CSS" (p.2084).	Cross-sectional, secondary analysis	**Sample:** n=3546 **Sex**: Male n=1576, female n=1746. **Age:** 12.5-17.9 years **Country**: Multicentre investigation conducted in ten European cities, 9 countries: Austria, Belgium, France, Germany, Greece, Hungary, Italy, Spain, and Sweden. **Sampling Method**: Data from HELENA European Stats collected in 2006-2007. Random cluster sample stratified by geographical location, age and socio-economic level of all students from a selection of classes from all schools in selected cities.	Approximately 60% of adolescents answered the nutritional knowledge questionnaire correct. There was a general misconception regarding sugar, adolescents tended to underestimate sugar content, ie) ketchup and soft drinks. No significant correlation was found between nutritional knowledge and BMI. Parental education level was the only SES indicator found to affect adolescent nutritional knowledge, nutritional behaviours and BMI. Adolescents from parents with higher education had healthy nutritional behaviours. **Sex:** Females had significantly higher total nutritional knowledge scores (NKT) scores compared with males (62% vs. 59%). The smoking status and educational level of the mother influenced the total NKT score significantly for males: non-smokers had a slightly higher mean score compared with smokers (57% vs. 60%), and the total NKT score increased with the educational level of the mother. The educational levels of both parents influenced the total NKT score significantly for females. Total NKT score for males and females increased significantly with the educational level of the mother (from 58 % to 64 %).
Souza Santos et al., 2019	"To analyse the Nutritional Knowledge Test (NKT) using Item Response Theory (ITR) analysis and to assess the construct validity of the Nutritional Knowledge Scale (NKTS) and its associations with adolescent food group consumption and nutritional biomarkers" (419).	Cross-sectional, secondary analysis	**Sample:** n=3215 **Sex:** male 47.5%, female 52.5% **Age:** 12.5-17.5 years **Country:** Multicentre investigation conducted in ten European cities, 9 countries: Austria, Belgium, France, Germany, Greece, Hungary, Italy, Spain, and Sweden. **Sampling Method:** Data from HELENA European Statistics, collected in 2006-2007. Random cluster sample stratified by geographical location, age and socio-economic level of all students from a selection of classes from all schools in selected cities.	"Nutrition knowledge was positively associated with consumption of fruits [p=0.01], cereals [p,0.001], dairy products [p,0.001], pulses, meat and eggs [p,0.001], and fish [p,0.001], as well as with blood concentrations of vitamin C, β-carotene, n-3 fatty acids, holo-transcobalamin, cobalamin and folate; nutrition knowledge was negatively associated with intake of olives and avocado [p=0.02], alcohol [p<0.001] and savoury snacks [p=0.02]" (p.419). Nutritional knowledge increased with age (p<0.001), gender (p=0.04), maternal education (p<0.001), and BMI (p=0.01); 74% of those with advanced nutritional knowledge were normal weight vs 6% underweight, 15.9% overweight, and 4.1% measured as obese according to the BMI. Higher maternal education was associated with increased nutritional knowledge (p<0.001). **Sex:** Females had higher nutritional knowledge (p=0.04) than males.
Tarabashkina et al., 2016.	To assess the association between food consumption and nutritional knowledge and food evaluations (p.146). To examine the moderating role of nutritional knowledge in the relationship between product evaluation and children's consumption of less healthy foods (p.146)	Not stated, but description is cross-sectional.	**Sample**: 354 **Sex:** Youth - 53.7% female, parent-80.2% female **Age:** Youth -7-13 years, parents - 62.3% 36-45 years. **Country:** Australia **Sampling method**: Recruited from an annual fair visited by families in south Australia in 2011.	Increased consumption of fast food by children was associated to taste and perceived social acceptability, as opposed to being perceived as fun or healthy. Higher nutritional knowledge weakened the relationship between product evaluations and consumption in children younger than 11 years. Parents with higher nutritional knowledge had children who tended to consume less-healthy foods less frequently. Although older children (11–13 years) possessed higher nutritional knowledge, it was not associated with their dietary behaviours; "instead, taste and perception of social acceptability were the only factors associated with frequent consumption of less healthy products". (148)
Utter et al., 2013.	"To examine the relationship between family meals and nutrition behaviors of adolescents" (p.3).	Secondary analysis of Youth'07, a national representative survey (3) – cross-sectional.	**Sample:** n= 9107 **Sex:** 4691 males, 4043 females **Age:** Between 13-17 years **Country:** New Zealand **Sampling Method:** "Data were collected as part of Youth'07, a survey of the health and well-being of New Zealand youth" (p.4). Survey respondents were randomly selected	Family meals were shared by 60% of participant 5 or more times a week. Frequency of family meals was positively associated with FVC, consumption of breakfast, healthy food recall from past week, less unhealthy food consumption and increased healthy food availability in home environment. There was no significant relationship found between family meals and BMI. **Sex:** "Students who shared meals with their families most frequently (7 or more times per week) were most likely to be male, of younger age, and Asian ethnicity" (p.5).

			from 96 schools who agreed to participate and were randomly selected from 389 eligible schools using a 2-stage sampling design.	
Vaitkeviciute et al., 2014.	"The present systematic review aimed to investigate the association between food literacy and adolescents' dietary intake"(p.650). .	Systematic review	**Sample:** 13 studies included **Age:** Studies with subjects aged 10-19 years of age **Country:** of review, Australia **Sampling Method:** Studies where food literacy attributes were included in the measured variables.	Three broad approaches were identified. 1. Relationship between food knowledge and dietary intake, 6/9 studies found a positive association. 2. Relationship between food skills and dietary intake, one study, found that increased food skills were associated with increased food confidence and vegetable consumption. 3. Relationship between food behaviours and dietary intake, 2/ 4 studies found positive associations, including frequency of cooking or engagement in food preparation increased fruit and vegetable consumption. While cross sectional studies were found to demonstrate cooking interventions as having a positive short-term relationship between food literacy and dietary intake, there was a lack of longitudinal studies to verify this relationship. One longitudinal study reviewed found adolescents who assisted in preparing dinner were more likely to engage in food preparation behaviours 5 years later. **Sex:** "Four studies revealed that females had greater food knowledge than males" (p.655). "One study found that females had greater food knowledge, but poorer dietary practices compared with males" (p.655). " Three studies found that female adolescents were more involved in food-related tasks and read food labels more frequently compared with male adolescents" (p.655).
Videon, & Manning, 2003.	"To provide national estimates of the frequency and determinants of adolescents' consumption of fruits, vegetables, and dairy foods" (p.365), and to see whether parental presence when adolescents leave for, and return from, school influences their consumption of various foods.	Secondary analysis of data collected from the first interview of the National Longitudinal study of Adolescent Health – Cross-sectional.	**Sample:** n=18,177, **Sex:** 51% male, 49% female **Age:** μ age=15.9 years, **Country:** USA **Sampling Method:** All 7th through 12th grade students who do not live alone or in an institutional setting in USA, were invited to participate. Systematic sampling method to achieve results that were a national representation.	"Adolescents with better-educated parents had better consumption patterns than those with less-educated parents" (p.365). "Adolescents who perceived themselves to be overweight were significantly more likely to have poor consumption patterns" (p.365). Parental presence at the evening meal was associated with a lower risk of poor FVC, low consumption of diary foods, and of skipping breakfast (p.365). "The presence of a parent in the home when adolescents left for, and returned from, school was not significantly associated with the adolescent's consumption of vegetables, fruits, and dairy foods" (p.369). **Sex:** "Girls and older adolescents were significantly more likely to report eating nothing for breakfast and poor consumption of dairy foods in the previous day than boys and younger adolescents." (p.368).

Key themes identified during data extraction were explored according to the food literacy attributes outlined in the framework developed by Thomas et al., 2019 (Table 3). Of the 28 studies included, there were no articles that included all food literacy attributes, however the study by Ronto et al. (2016) explored food literacy as related to every food literacy category. Twenty-seven studies examined relationships between individual food literacy attributes and either perceived, observed, or measured dietary behaviour. The study by Sichert-Hellert et al. (2011) did not directly discuss dietary behaviours, however the study explored relationships between food literacy attributes of nutritional knowledge, socio-economic status (SES), and sex. The study also included nutritional knowledge questions that revealed misconceptions related to sugar contents in foods, which may impact adolescent choices in dietary behaviour and as such was found to inform the current study objectives. Individual characteristics of food literacy were discussed in nine studies; five reported associations between increasing food literacy attributes and healthy dietary behaviour (Bailey et al., 2019; Brooks & Begley, 2014; Gracey et al., 1996; Souza Santos et al., 2019; Vaitlevicuiute et al., 2014), and three found no associations (Lai Yeung, 2010; Nagy-Pénzes et al., 2020; Tarabashkina et al., 2016). Societal characteristics of food literacy were discussed in 23 studies; all but two (Mokhtari et al., 2017; Tarabashkina et al., 2016) reported higher SES or healthier home learning environments as being related to healthier dietary behaviours, and one study (Pitel et al., 2013) found minimal impact on dietary behaviour. Socio economic status was explored in 13 studies (Bau et al., 2011; Chartatos et al., 2018; Fleary et al., 2018; Ghasab et al., 2017; Gracey et al., 1996; Nagy-Pénzes et al., 2020; Park et al., 2013; Pearson et al., 2020; Pitel et al, 2013; Sichert-Hellert et al., 2011; Souza Santos et al., 2019; Tarabashkina et al., 2016; Videon & Manning, 2003) and the home learning environment in 10 studies (Brooks & Begley, 2014; do Amaral e Melo et al., 2020; Garrido-Fernández et al., 2020;

Hanson et al., 2004; Lake et al., 2004; Mokhtari et al., 2017; Orehek & Ferrer, 2018; Sanchez et al., 2007; Utter et al., 2013; Videon & Manning, 2003).

Table 3

Food Literacy Attributes Within the Selected Studies (N=28).

Author	***Food and Nutritional Knowledge***			***Food Skills***	***Self-Efficacy and Confidence***				***External Factors***		***Food Decisions***
	Food knowledge	Nutritional Knowledge	Food and Nutritional Language	Food techniques	Nutritional Literacy	Food and Nutritional Self-Efficacy	Cooking Self-Efficacy	Food Attitudes	Food systems	SDH	Dietary Behaviours
Bailey, et al. (2019).	X	X		X	X		X	X	X		X
Bau et al. (2011).										X	X
Brooks & Begley. (2014).	X	X	X	X		X	X	X	X	X	X
Chortatos et al., 2018					X	X	X	X		X	X
Do Amaral e Melo et al., 2020										X	X
Fleary et al. (2018).		X	X		X					X	X
Garrido-Fernández et al., 2018					X	X	X	X		X	X
Ghasab et al.. (2017).		X				X		X		X	X
Gracey et al. (1996).		X	X		X	X		X		X	X
Hanson et al. (2004).										X	X
Lai Yeung, W. T. (2010).	X	X		X	X			X	X	X	X
Lake et al. (2004).		X						X		X	X
Mokhtari et al. (2017).	X	X	X	X	X					X	X
Nagy-Pénzes et al., 2020		X									X
Orehek & Ferrer. (2018).								X		X	X
Park et al. (2013).									X	X	X
Pearson et al. (2009).										X	X
Pitel et al. (2013).										X	X
Raber et al. (2018).				X	X		X			X	X
Ronto et al. (2016).	X	X	X	X	X	X	X	X	X		X
Sahingoz & Sanlier. (2011).	X	X	X					X		X	X
Sanchez et al.. (2007).										X	X
Sichert-Hellert et al. (2011).	X	X	X							X	
Souza Santos et al., 2019	X	X	X							X	X
Tarabashkina et al. (2016).		X						X	X	X	X
Utter et al. (2013).										X	X
Vaitlevicuiute et al.. (2014).	X	X		X	X	X					X
Videon & Manning. (2003).										X	X

Note. Food literacy attributes are adapted from "Complexities in conceptualizing and measuring food literacy" by H. Thomas et al., 2019, *Journal of the Academy of Nutrition and Dietetics, 119*(4), 563-573.

Study Characteristics

The earliest study included was from 1996, and although no limits were placed on dates during the search process, 79% of the studies (n=22/28) were published within the last decade (2010-2020), demonstrating the increased emphasis on food literacy concepts. Global diversity was evident within the included studies: 29% originated from Oceania (n=8/28, seven studies from Australia and one from New Zealand), 21% from North America (n=6/28, six studies from the United States), 29% from Europe (n=8/28, 1 each from the United Kingdom, Germany, Slovakia, Norway, Spain, Hungary, and two representing nine European nations), 11% from the Middle East (n=3/28, two from Iran and one from Turkey), 7% from Asia (n=2/28, one each from Hong Kong and South Korea), and 4% from South America (n=1/28, Brazil).

Sample. Study samples included participants who ranged in age from 7 to 23 years, and all studies included had populations between 12 and 17 years of age. Two longitudinal perspective cohort studies were included: one study spanned two years with study participants ranging from 12 to 17 years (Pearson et al., 2009), the second spanned 20 years and had a mean age of 32.5 years at the 20-year follow-up (Lake et al., 2004). Nine studies collected data from both the adolescent and the accompanying parent. The majority of parent study participants were female, ranging from 75% to 89.8%, five studies did not report parental sex but collected data from parents who reside with the adolescent. Primary study sample sizes ranged from 31 to 18,177 participants. A total of 10 studies had over a thousand participants within their sample, of which six were from national databases. Data was analysed from different national databases in the United States (n=2/6 from national data bases), New Zealand (n=1/6 from national data bases) and Germany (n=1/6 from national data bases). The same data base was analysed in two European studies (HELENA study, 2006-2007). Although the majority of studies included both

male and female participants, two studies focused only on adolescent females (Bau et al., 2011 et al., 2011; Mokhtari et al., 2017). The majority of study participants were purposefully recruited through high schools, representing 68% of primary studies (n=15/22 primary studies). The remaining 32% of the studies (n=7/22 primary studies) recruited participants by convenience sampling, such as from an annual fair or primary care providers; by random cluster samples; or by purposeful sampling through data bases and advertising.

Study Design. Twenty studies used a cross-sectional design, two used a mixed qualitative and quantitative design, and six were knowledge synthesis studies. Two longitudinal perspective cohort studies collected cross sectional data from participants at two different points, a United Kingdom study that collected data from participants aged 11 to 12, then again 20 years following (Lake et al., 2004), and an Australian study where data was collected from participants aged 12-13 and 14-15 years of age and again after two years (Pearson et al., 2009). Seven studies were cross-sectional analyses of larger national studies. Most primary studies used questionnaires or surveys to gather data (n=19/22 primary studies), two used mixed methodology including questionnaires and focus groups (Chartatos et al., 2018; Ronto et al., 2106), and one conducted a secondary analysis of two observational studies (Raber et al., 2013). Theoretical underpinnings or models used in studies included the social cognitive theory (Hanson et al., 2004; Ronto et al., 2016), social ecological model (Ghasab et al., 2017), health belief model, theory of planned behaviour and stages of change model (Gracey et al., 1996), food-related lifestyle model (Lai-Yeung), social psychological theory (Orehek & Ferrer, 2018), and classical test theory and the item response theory (Souza Santos et al., 2019; Tarabashkina et al., 2016). Three primary studies reported frameworks, including partial nominal group technique (Ronto et al., 2016), STROBE (a checklist to Strengthen the Reporting of Observational Studies in

Epidemiology) (Raber et al., 2018), and the social cognitive framework (Hanson et al., 2004). Four of the six knowledge synthesis studies applied frameworks; PRISMA (n=4/28) (Bailey et al., 2019; do Amaral e Melo et al., 2020; Fleary et al., 2018; Vaitkeviciute et al., 2014) and PICOS (n=1/28) (Bailey et al., 2019).

Food Literacy Variables. Food literacy is a complex emerging concept (Brooks & Begley, 2014; Vidgen & Gallegos, 2014) and as such measurements of food literacy varied between studies. Dietary behaviours, external factors, and nutritional knowledge were the most common food literacy attributes measured. Dietary behaviours were a dependent variable in 21 of the 22 primary studies (Table 3). The most common food behaviour outcome measured was the consumption of fruits and vegetables (n=16/22 primary studies) (Bau et al., 2011; Chartatos et al., 2018; Hanson et al., 2004; Lai Yeung, 2010; Nagy-Pénzes et al., 2020; Orehek & Ferrer, 2018; Park et al., 2013; Pearson at al., 2009; Pitel et al., 2013; Raber et al., 2018; Ronto et al., 2016; Sanchez et al., 2007; Souza Santos et al., 2019; Utter et al., 2013; Videon & Manning, 2003). Additionally, two primary studies included fruits and vegetables, but in the context of measuring food behaviour against the national food guidelines, which included these foods (Lake et al., 2004; Mokhtari et al., 2017). Four of the knowledge synthesis studies included dietary behaviours as part of their inclusion criteria (do Amaral e Melo et al., 2020; Fleary et al., 2018; Ghasab et al., 2017; Vaitkeviciute et al., 2014). The consumption of unhealthy foods, such as fast foods, chocolate, soda, and sweets, in addition to snacking between meals, was the second most common dietary behaviour measured (n=13/22 primary studies) (Bau et al., 2011; Chartatos et al., 2018; Garrido-Fernández et al., 2020; Gracey et al., 1996; Nagy-Pénzes et al., 2020; Orehek & Ferrer, 2018; Park et al., 2013; Pearson at al., 2009; Pitel et al., 2013; Raber et al., 2018; Sauza Santos et al., 1019; Tarabashkina et al., 2016; Utter et al., 2013). The third most common dietary

behaviour measured was skipping meals (n=11/22 primary studies) (Bau et al., 2011; Chartatos et al., 2020; Garrido-Fernández et al., 2020; Lai Yeung, 2010; Nagy-Pénzes et al., 2020; Park et al., 2013; Pearson at al., 2009; Pitel et al., 2013; Sahingoz & Sanlier, 2011; Utter et al., 2013; Videon & Manning, 2003). Dietary intake in primary studies was also measured by dairy (n=4/22 primary studies) (Hanson et al., 2004; Park et al., 2013; Sauza Santos et al., 1019; Videon & Manning, 2003), fat intake (n=2/22 primary studies) (Gracey et al., 1996; Sanchez et al., 2007), portion sizes (n=2/22 primary studies) (Bau et al., 2011; Ronto et al., 2016), according to the national nutrition guidelines (n=2/22 primary studies) (Lake et al., 2004; Mokhtari et al., 2016) and, family meals were discussed in relation to dietary behaviours (n=2/22 primary studies) (Bau et al., 2011; 2013; Utter et al., 2013).

External factors were discussed in 26 studies (n=26/28). Individual food literacy attributes discussed included nutritional knowledge and food knowledge (n=9/22 primary studies) (Gracey et al., 1996; Lai Yeung, 2010; Lake et al., 2004; Nagy-Pénzes et al., 2020; Raber et al., 2018; Sahingoz & Sanlier, 2011; Sichert-Hellert et al., 2011; Sauza Santos et al., 1019; Tarabashkina et al., 2016), food skills (n=3/22 primary studies) (Lai Yeung, 2010; Raber et al., 2018; Ronto et al., 2016), and self-efficacy and confidence (including readiness to change) (n=10/22 primary studies) (Chartatos et al., 2018; Garrido-Fernández et al., 2018; Gracey et al., 1996; Lai Yeung, 2010; Lake et al., 2004; Orehek & Ferrer, 2018; Raber et al., 2018; Ronto et al., 2016; Sahingoz & Sanlier, 2011; Tarabashkina et al., 2016). Risk behaviours (physical inactivity, consumption of alcohol, cigarettes, and cannabis) and their association to food behaviours were also discussed (n=4/22 primary studies) (Orehek & Ferrer, 2018; Pitel et al., 2013; Sanchez et al., 2007; Sauza Santos et al., 1019).

Terminology and Measurement Variances in the Literature. Food literacy was defined four times within the reviewed studies, and these studies were the only ones to cite the term in their title. The most cited definition of food literacy was developed by Vidgen and Gallegos (2012, 2014), describing food literacy as "a collection of inter-related knowledge, skills and behaviours required to plan, manage, select, prepare and eat foods to meet needs and determine food intake" (Bailey et al., 2019; Vaitkeviciute et al., 2014). The second definition cited was an earlier definition by Vidgen and Galegos from 2011 (Brooks & Begley, 2014). The third definition shared many of the same elements as the first but expanded the concept to include the larger ecological attributes that exist outside the individual (Ronto et al., 2016). The remining studies discussed varying attributes of food literacy, including nutritional knowledge, food skills, dietary behaviour, and SES.

No study directly defined nutritional knowledge; however, several discussed their assessment of nutritional knowledge captured within their questionnaires (Gracey et al., 1996; Lai Yeung, 2010, Ronto et al., 2016; Sahingoz & Sanlier, 2011; Sichert-Hellert et al., 2011; Souza Santos et al., 2019; Vaitkeviciute et al., 2014), based on national guidelines (Gracey et al., 1996), school curriculum (Lai Yeung, 2010), or aimed at assessing knowledge related to nutrients in common foods (Gracey et al., 1996; Souza Santos et al., 2019).

Food skills and healthy dietary behaviours were not defined as a concept, but described within each study, usually as a component of a questionnaire (Bailey et al., 2019; Chartatos et al., 2018; Garrido-Fernández et al., 2020; Lai Yeung, 2010; Nagy-Pénzes et al., 2020; Orehek & Ferrer, 2018; Ronto et al., 2016; Souxa Santos et al., 2019; Vaitkeviciute et al., 2014), or by varying outcomes such as daily or weekly consumption of different food items.

Socio-economic status varied in measurement and definitions: measured by household education only (n=6/28) (Chartatos et al., 2018; Pitel et al., 2013; Raber et al., 2018; Sahingoz & Sanlier, 2011; Sanchez et al., 2007; Videon & Manning, 2003); by maternal education only (n=1/28) (Pearson at al., 2009); by a combination of household education and income status (n=2/28) (Bau et al., 2011; Sichert-Hellert et al., 2011); by a combination of household education and employment status (n=1/28) (Garrido-Fernández et al., 2020); by a combination of household education, income or affluence level, and employment status (n=3/28) (Hanson et al., 2004; Nagy-Pénzes et al., 2020; Souza Santos et al., 2019); based on a national register general (Lake et al., 2004) or bureau of statistics calculation (n=3/28) (Lai Yeung, 2010, Tarabashkina et al., 2016; Utter et al., 2013); and SES associated with the school (n=1/28) (Gracey et al., 1996). Additionally, each measurement of education level varied. Low classifications of education levels ranged from illiterate (Garrido-Fernández et al., 2020; Sahingoz & Sanlier, 2011) to below high school (Chartatos et al., 2018; Pearson at al., 2009; Raber et al., 2018; Souza Santos et al., 2019; Videon & Manning, 2003), including primary school (Garrido-Fernández et al., 2020; Sahingoz & Sanlier, 2011; Souza Santos et al., 2019) elementary and apprentice level (Nagy-Pénzes et al., 2020; Pitel et al., 2013). High education levels ranged from college (Raber et al., 2018; Videon & Manning, 2003), university (Garrido-Fernández et al., 2020; Nagy-Pénzes et al., 2020; Pearson at al., 2009; Pitel et al., 2013; Sahingoz & Sanlier, 2011; Souza Santos et al., 2019), or postgraduate (Raber et al., 2018).

Food Literacy Themes Within the Literature

Recurring themes associated with the relationship between food literacy and adolescent dietary behaviours include both individual and societal factors. Additionally, demographic differences, such as sex and age, emerged as dominant themes.

Food and Nutritional Knowledge. Fifteen studies discussed the individual characteristics of food and nutritional knowledge (Bailey et al., 2019; Brooks & Begley, 2014; Fleary et al., 2018; Gracey et al., 1996: Lake et al., 2004: Lai Yeung, 2010, Mokhtari et al., 2017; Nagy-Pénzes et al., 2020; Ronto et al., 2016: Sahingoz & Sanlier, 2011: Sichert-Hellert et al., 2011: Souza Santos et al., 2019; Tarabashkina et al., 2016: Vaitkeviciute et al., 2014). Most studies did not distinguish between the attributes of food and nutritional knowledge, food knowledge, nutritional knowledge, and food and nutritional language, with the exception of Ronto et al. (2016). Although the Ronto et al. study included all food and nutritional knowledge attributes, this study did not measure impact of food literacy on dietary behaviour. Two knowledge synthesis studies discussed two of the three attributes: food knowledge and nutritional knowledge (Bailey et al., 2019; Vaitkeviciute et al., 2014).

The effect food and nutritional knowledge had on adolescent dietary behaviours was found to be inconsistent. Increased food and nutritional knowledge were associated with healthy dietary behaviours including lower rates of breakfast skipping ($p<0.01$) (Sahingoz & Sanlier, 2011), lower consumption of convenience foods (Bailey et al., 2019; Fleary et al., 2018; Vaitkeviciute et al., 2014) such as ‘savory snacks’ ($p=0.02$) (Souza Santos et al., 2019), increased FVC (Bailey et al., 2019; Fleary et al., 2018; Lake et al., 2004), increased fruit consumption ($p=0.01$) (Souza Santos et al., 2019) and higher food safety practices (Bailey et al., 2019). However, limited association between ‘food and nutritional knowledge’ and dietary behaviour was also found in three studies (Lai Yeung, 2011; Nagy-Pénzes et al., 2020; Tarabashkina et al., 2016). Adolescents were found to have knowledge deficits related to fat content and to underestimate the sugar content in products such as ketchup and soft drinks (Gracey et al., 1996; Sichert-Hellert et al., 2011 et al.). On a nutritional knowledge questionnaire,

60% or more adolescents answered all nutritional knowledge questions correctly except for the questions related to fats, which scored between 34.9-51.5% (Gracey et al., 1996 et al). Several studies found that despite some adolescents having higher nutritional knowledge scores, this knowledge did not always translate into practice (Nagy-Pénzes et al., 2020; Ronto et al., 2016 et al., year) and they continued to choose convenience foods and consume low levels of fruits and vegetables (Ghasab et al., 2017; Lai Yeung, 2010; Tarabashikna). A study by Nagy-Pénzes et al. (2020) found that factors within the home environment, such as parental education and family affluence level, impacted dietary behaviours, finding no significant association to nutritional knowledge.

Only one study directly discussed the attribute of food and nutrition language, finding that most adolescents were unfamiliar with the term food literacy (Ronto et al., 2016), however, studies that discussed nutritional knowledge often included some nutrient terminology, such as joual for energy, carbohydrate, protein, and fiber (Gracey et al., 1996; Sichert-Hellert et al., 2011; Souza Santos et al., 2019).

Food Skills. Food skills represented an underexplored category of food literacy, with only seven studies investigating food skills (Bailey et al. 2019; Brooks & Begley, 2014; Lai Yeung, 2010; Mokhtari et al., 2017; Raber et al., 2018; Ronto et al., 2016; Vaitkeviciute et al., 2014), of which three were knowledge synthesis studies (Bailey et al., 2019; Brooks & Begley, 2014; Vaitkeviciute et al., 2014). One study reported to have asked questions related to food safety but never discussed the responses (Mokhtari et al., 2017). Another study reported that 47% to 57% of adolescents learned cooking skills at home, however there was no discussion related to the impact these skills had on dietary behaviour or evaluation of the degree to which these skills were taught (Lai Yeung, 2010).

Food literacy programs which included interventions that taught cooking skills were positively associated with reports of increased cooking self-efficacy (Bailey et al., 2019), FVC (Bailey et al., 2019; Brooks & Begley, 2014; Vaitkeviciute et al., 2014), lower consumption of unhealthy foods (Vaitkeviciute et al., 2014), and an increased willingness to taste new foods (Bailey et al., 2019). Adolescents who participated in meal preparation skills were more likely to engage in meal preparation five years later (Vaitlevicuite et al., 2014). Adolescents reported they had sufficient knowledge related to food safety from their formal and informal education and perceived themselves to have sufficient nutritional knowledge, however, were unable to translate this knowledge into practice due to low confidence in food skills (Ronto et al., 2016). A secondary analysis of two eButton trials further supports the assessment that adolescents possess low confidence in food skills, reporting adolescents engaged minimally in food preparation activities within the home setting, mainly browsing (71% fridge browsing) and preparing foods with minimal ingredients (45.2% combing 2 plus ingredients) or opening packages (41.9%) and cooking in the microwave (22.6%) (Raber et al., 2018).

Self-Efficacy and Confidence. Sixteen studies discussed one or more of the attributes of self-efficacy and confidence, nine of which discussed the attribute of nutrition literacy in relation to the reading of food labels (Bailey et al., 2019, Fleary et al., 2018; Gracey et al., 1996; Lake et al., 2004; Lai Yeung, 2010; Mokhtari et al., 2017; Raber et al., 2018; Ronto et al., 2016; Vaitkeviciute et al., 2014). Although adolescents reported confidence in their ability to read nutritional labels, one study reported that adolescents frequently did not read nutritional labels as they lacked the knowledge to understand the label or perceived the nutritional labels as too complicated (Ronto et al., 2016). However, no association was reported between an adolescent's

confidence to read food labels and dietary behaviour (Gracey et al., 1996; Vaitkeviciute et al., 2014).

Self-efficacy related to nutritional literacy was also examined in relation to adolescents' ability to distinguish accurate information from the media and assess its impact on their nutritional behaviours (Fleary et al., 2018; Lake et al., 2004; Raber et al., 2018; Ronto et al., 2016). Adolescents were reported to not understand that all information on the internet was not reliable (Ronto et al., 2016). As the age of adolescents increased, they were reported to observe food media more frequently (23.1% vs. 0%), however the impact of this viewing was not assessed (Raber et al., 2018). Longitudinally, at a 20 year follow up, respondents reported media having a positive impact on their present diet. While study respondents reported that as adolescents they perceived very little healthy food promotion to be present in the media; the study did not report on the impact of negative food media (Lake et al., 2004).

Food and nutritional self-efficacy, or the confidence to select and prepare food, was discussed in three studies (Fleary et al., 2018; Gracey et al., 1996; Chartatos et al., 2018., 2019). The ability to make dietary decisions based on food labels was associated with healthier nutritional behaviour (Fleary et al., 2018). Adolescents who tried to eat healthy or considered their food choices to be healthy had higher self-efficacy scores as compared to those who reported unhealthy diets (Gracey et al., 1996). Higher self-efficacy scores in adolescents were associated with healthier food choices compared to unhealthy food choices ($p<0.05$) (Gracey et al., 1996). Additionally, higher self-efficacy scores were associated with lower use of school canteen and increased home packed lunch as compared to adolescents with lower self-efficacy scores ($p=0.001$) (Chartatos et al., 2018). Higher school canteen use was associated with increased consumption of 'salty snacks' (p,0.03), 'baked sweets' ($p=0.007$) and 'soft drinks'

($p=0.002$) (Chartatos et al., 2018), supporting the aforementioned relationship between higher self-efficacy and healthier food choices. Although 78% of adolescents in one study reported to have been taught skills related to shopping, their self-efficacy to translate this knowledge to practice was not evaluated (Lai Yeung, 2010). Cooking self-efficacy was associated positively to programs that incorporated food skills within their interventions (Bailey et al., 2019; Vaitkeviciute et al., 2014).

Adolescents were found to report a positive attitude towards learning to cook and about healthy foods (Bailey et al., 2019; Brooks & Begley, 2014; Gracey et al., 1996; Lake et al. 2004; Lai Yeung, 2010; Orehek & Ferrer, 2018; Raber et al., 2018; Tarabashkina et al., 2016). Adolescents reported in focus groups that they felt that the school canteen could offer healthier alternatives to aid in the promotion of a healthy diet (Chartatos et al., 2018). Adolescents perceived that a healthy attitude towards diet would result in a healthy diet (Ronto et al., 2016), viewing FVC as healthy and processed foods as unhealthy (Bailey et al., 2019). Adolescents who tried to eat healthy had lower dietary intake of fats (mean 5.3, CI 5.0-5.6) compared to those who did not try to eat healthy (mean 5.8, CI 5.4-6.2) (Gracey et al., 1996), however it was also reported that adolescents reported their dietary decisions to be largely influenced by taste ($p<0.05$) (Tarabashkina et al., 2016) and perception of social acceptability ($p<0.01$) (Tarabashkina et al., 2016). Adolescents valued social eating experiences, including family meals (Ronto et al., 2016; Utter et al., 2013).

Although adolescents placed value on healthy eating and food skills, they often did not apply these values to their dietary practices due to their beliefs and attitudes towards what was important in adolescents. For example, while adolescents felt it was important to follow national guidelines, they often did not put this value into action due to a belief that only those on strict

diets needed to do so, and their belief that the growing adolescent body did not need to follow such guidelines (Ronto et al., 2016). Additionally, although adolescents viewed food skills to be beneficial over the course of their lives, they may not view food skills to be important in their adolescent years, but rather as skills they would need when they had families of their own (Ronto et al., 2016).

Societal/ External Ecological Factors. Few studies examined food systems. Adolescents were found to have limited macro level knowledge regarding their food systems, however when introduced to the concept, males ranked the importance of 'knowing where their food came from' (mean 1.9) higher than females (mean 0.5) ($p \leq 0.05$) (Ronto et al., 2016).

Changes within the food system have promoted a high density of supermarkets, traditional markets, and fast-food outlets in lower SES neighborhoods, creating obesogenic environments that have been found to negatively impact the consumption patterns of adolescents who reside within these neighborhoods (Burgoine et al., 2016; Townshend & Lake, 2017). The effect of obesogenic environments on adolescents was evident in the Park et al., (2013) study, which found that adolescents living in neighborhoods with a high density of fast-food outlets were more likely to be obese, as compared to those living in less dense neighborhoods, however although the adolescents healthy eating index scores were lower for those who resided in high density neighborhoods comparatively to those in less dense neighbourhoods, the scores were not statistically significant (Park et al., 2013). The food system was also represented by the presence of a school cafeterias/ canteens and neighbouring shops within school neighborhoods (Chartots et al., 2018; Garrido-Fernández et al., 2020). 'Often' use of the school canteen was associated with higher intake of unhealthy snacks compared to the adolescents who 'never' used the canteen, as evident in the consumption of soft drinks where 19.6% of adolescents who 'often'

visited the school canteen regularly consumed soft drinks compared to 7.9% of those who 'never' visited the canteen (Chartatos et al., 2018). Additionally, adolescents from schools with a cafeteria were more likely to consume snacks with sweets (OR 1.93, CI 1.67-2.23), candy (OR 2.75, CI 2.39-3.19), and bagged crisps (OR 3.6, CI 2.65-3.54) (Garrido-Fernández et al., 2020). Although the number of shops in the school neighbourhood did not statistical impact the overall number of purchase (p=0.09), when there were fewer than three shops nearby, those adolescents who visited the canteen 'often' made purchase from shops 39.8% of the time, and when there were three or more shops nearby these adolescents' purchases increased to 60.2% (Chartatos et al., 2018).

Measurements of SES were inconsistent across the studies, comprised of varying combinations of household education measurements, income, and SES indicators. Socio-economic status was frequently measured in the included studies (n =15/28), with several studies collecting socio-economic variables but never reporting the related data in relation food literacy attributes and diet behaviour (Hanson et al., 2004; Mokhtari et al., 2017; Raber, 2018).

Despite varying measurements of SES, higher SES was generally associated with healthier dietary behaviours among adolescents. The studies that measured and discussed household income reported positive associations between higher household income, diet behaviours and/ or weights status (Fleary et al., 2018; Ghasab et al., 2017; Gracey et al., 1996; Park et al., 2013; Souza Santos et al., 2019). Students from schools with lower SES reported skipping breakfast more frequently (p=0.014) and had lower food variety scores (p=0.034) (Gracey et al., 1996). Female adolescents in higher SES schools had lower consumption of soft drinks (p=0.0005) as compared to those in lower SES schools, and higher consumption of water (p=0.031) (Gracey et al., 1996). Adolescents who came from higher SES schools or higher

income homes had healthier nutrition behaviours (Ghasab et al., 2017; Gracey et al., 1996) and higher levels of health literacy. High levels of health literacy were found to have positive associations with health behaviours, including higher FVC and lower smoking and alcohol usage (Fleary et al., 2018). Adolescents who smoke ($p=0.041$) or drink alcohol ($p=0.012$) had higher levels of dietary fat than adolescents that did not smoke or drink (Gracey et al., 1996).

Twelve of the 13 studies that measured SES by level of parental education found that as the level of parental education increased, adolescent nutritional knowledge increased (Nagy-Pénzes et al., 2020; Sahingoz & Sanlier, 2011; Sichert-Hellert et al., 2011; Souza Santos et al., 2019). High maternal education as compared to low maternal education was associated with higher adolescent nutritional knowledge ($p<0.001$) (Souza Santos et al., 2019), healthy weight status increased (Bau et al., 2011; Souza Santos et al., 2019), and healthier dietary behaviour increased ($p<0.05$) (Sahingoz & Sanlier, 2011) (Bau et al., 2011; Chartatos et al., 2018; Garrido-Fernández et al., 2019; Ghasab et al., 2017; Fleary et al., 2018; Nagy-Pénzes et al., 2020; Pearson at al., 2009; Pitel et al., 2013). The higher the level of parental education, the lower the frequency of adolescents breakfast skipping ($p<0.05$ – Videon & Manning, 2003) ($p<0.01$ – Pitel et al., 2013), the lower the likelihood of adolescents consuming low levels of fruits and vegetables daily ($p<0.001$) (Videon & Manning, 2003), and the lower the consumption of convenience foods by adolescents (college educated compared to high school educated, $p<0.05$) (Videon & Manning, 2003). A study that measured SES through a combination of parental education and employment status found that the odds of female adolescents having a food frequency score below the 25th percentile were higher among females who came from lower SES compared to those from high SES (OR 3-6 , CI 2.1-6.0, $p<0.001$) (Bau et al., 2011, p.1760,

1763). Adolescents from households with parents who had a higher education had higher health literacy, which was associated with higher FVC (Fleary et al., 2018 et al).

Opportunities for learning and practicing food literacy include family meals, availability of healthy foods, and household composition which may affect meal preparation time, and parental modeling. Adolescents who participate in an increasing number of family meals per week were found to be more likely to consume five or more fruits and vegetables per day ($p<0.001$) (Utter et al., 2013), 19% to 38% less likely to report poor vegetable consumption (Videon & Manning, 2003), more likely to always consume of breakfast ($p<0.001$) (Utter et al., 2013), and consumed unhealthy foods less frequently in the past week ($p<0.001$) (Utter et al., 2013). The dietary benefits associated with increasing frequency of family meals listed above, including increased consumption of healthy foods and declining consumption of unhealthy foods are supported in a knowledge synthesis study by do Amaral e Melo et al. (2020). No significant correlations were found between serving vegetables at supper and adolescent FVC, however serving dairy was associated with increased dairy intake in males ($p<0.01$) (Hanson et al., 2004).

The most commonly reported barrier to healthy eating by adolescents, was the availability of healthy options within the home, and or school environments (Brooks & Begley, 2014; Ghasab et al, 2017; Gracey et al., 1996; Hanson et al., 2004; Utter et al., 2013). The availability of foods within the home environment impacted the types of foods consumed (Brooks & Begley, 2014; Ghasab et al., 2017; Gracey et al., 1996), with 45.1% of adolescents reporting the lack of healthy foods in the home as a barrier to healthy eating (Gracey et al., 1996). Several studies support the impact that food availability can have on adolescent dietary consumption. Female adolescents who resided in homes where soft drinks were available ‘always’ or ‘usually or sometimes’ compared to ‘never’, consumed approximately one fewer

servings of dairy per day (Hanson et al., 2004). The influence of the home food environment is further evident in another study that found as the availability of fruits and vegetables within the home increased the frequency of family meals increased; 96.5% of homes that reported the frequency of family meals as seven or more times a week also usually had fruits and vegetables available in the home, compared to 85.7% of those who reported frequency of family meals as fewer than two times a week (OR 4.69, CI 3.7-5.9, $p<0.001$) (Utter et al., 2013).

Household demographics were associated with adolescent food literacy. Female adolescents from two parent households had higher FVC (Bau et al., 2011). Utter et al. (2013) showed an increase in frequency of family meals for adolescents who lived with two parents verse one; meals eaten five to six times a week occurred 24.5% in two parent homes compared to 21.4% in single parent homes; and meals seven times a week occurred 36.4% in two parent homes compared to 31.2% in single parent homes.

Sex

Sex emerged as a key theme within the review. Male and female study participants were found to display differing individual food literacy attributes and dietary behaviours, in addition to experiencing varying impacts from societal factors, such as SES. Females were found to score higher in nutritional knowledge than males in seven out of eight studies that discussed or reported sex differences (Bailey et al., 2019; Ghasab et al., 2017; Gracey et al., 1996; Nagy-Pénzes et al., 2020; Sichert-Hellert et al., 2011; Souza Santos et al., 2019; Vaitkeviciute et al., 2014). In knowledge test scores females had a mean score of 5.3 compared to males 4.8 ($p=0.011$) (Gracey et al., 1996) and were found to have slightly higher nutritional knowledge scores than males in the Helena Studys ($p<.0001$ – $p=0.04$) (Sichert-Hellert et al., 2011; Souza

Santos et al., 2019). However, a study by Sahingoz & Sanlier (2011) found no significant differences in nutritional knowledge by sex.

Females were also found to have higher self-efficacy scores in relation to food and food related activities (Gracey et al., 1996), such as food preparation and reading food labels (Ghasab et al., 2017, Vaitkeviciute et al., 2014). A study that measured attitudes and values attributed to food, found the male adolescents place a significant higher value on the benefits of four types of meats compared to females (p values ranged between 0.01 - 0.0001) (Sahingoz & Sanlier, 2011, p.274). Whereas females were found to attribute a higher value towards FVC than males; females scored higher on questions such as "should consume fruits" ($p=0.007$) and "vegetables" ($p=0.003$) as compared to males (Sahingoz & Sanlier, 2011, p. 274). Additionally, a mixed methodology study found females between 15 and 17 years of age were more concerned about portion size than their male counterparts ($p\leq0.05$) (Ronto et al., 2016). Another study reported female diet decisions to be more impacted by weight control and appearance than their male counterparts, 85% of females' verses 67% of males kept watch of their weight ($p<.001$) (Lai Yeung, 2010). These findings highlight that value attributed to portion sizes, fruits and vegetables, and higher FVC should be viewed cautiously as these values and behaviours may be more related to concern over weight status and may not be representative of higher food literacy.

When measuring dietary behaviour through FVC, females frequently consumed higher levels than their male counterparts (Bailey et al., 2019; Ghasab et al., 2013; Park et al., 2013; Ronto et al., 2016; Sahingoz & Sanlier, 2011); females consumed higher levels of vegetables ($p\leq0.001$) and fruits ($p\leq0.05$) as compared to males (Pearson at al., 2009). Contradictory to study results reporting females to have higher FVC, one study found that 25.3% of females had a combination of all three risk factors associated with unhealthy weight (categorize as physical

inactivity, low FVC and unhealthy fat intake) compared to 14.2% of males (Sanchez et al., 2007). However, when measuring for only one risk factor - low FVC - females had a lower risk at 6.3% compared to males at 11.3% (Sanchez et al., 2007). Males were also found to have significantly higher fat consumption scores as compared to females (mean score 6 verses 5.4, $p<0.0001$); SES had no significant effect of the consumption scores (Gracey et al., 1996).

Although females are reported to have higher nutritional knowledge and self-efficacy, these attributes did not necessarily translate into healthier dietary behaviours. In a longitudinal study females and males demonstrated diet change in different areas; females demonstrated an increasing rate of breakfast skipping as compared to males (13.7% verses 10.2%, $p\leq0.01$), while males increased snacking (16% verses 7.8%, $p\leq0.001$) and their consumption of fast foods (26.2% verses 15.3%, $p\leq0.001$) as compared to females (Pearson at al., 2009). Consistent with the knowledge synthesis studies (Ghasab et al., 2013; Vaitkeviciute et al., 2014), primary studies within this review found that female adolescents skipped breakfast more frequently than males ($p<0.001$) (Videon & Manning, 2003); 34.6% (Pearson et al., 2009) to 40.7% (Park et al., 2013) of females skipped breakfast most days compared to 23.9% (Pearson et al., 2009) to 31% (Park et al., 2013) of males.

Socio-economic status was found to impact the dietary behaviours of females and males at different rates. While only 43.4% of females at low SES schools ate breakfast regularly, compared to 73.0% of females from high SES schools regularly consumed breakfast (χ^2 19.16, $p=0.0140$), male breakfast consumption between SES schools showed no statistically significant difference, ranging from 72.5% to 74.0% (Gracey et al., 1996). Another study reported similar findings, low SES compared to high SES among female adolescents was correlated to a higher

likelihood of no daily breakfast consumption (OR 1.50, CI 1.07-2.09, p=0.038), and no daily fruit (OR 2.05, CI 1.40-3.00, p<0.001) (Pitel et al., 2013).

Socio-economic status was frequently measured by either highest level of household education (n-8/28) (Bau et al., 2011; Hanson et al., 2004; Pitel et al., 2013; Sahingoz & Saniler, 2011; Sanchez et al., 2007; Sichert-Hellert et al., 2011; Videon et al., 2003) or maternal educational (n=1/28) (Pearson et al., 2009). Higher household education was associated with a lower likelihood of poor female dietary behaviour; no breakfast (p=0.038), no daily fruit (p<0.001), and no daily vegetables (p=0.001), however no significant relationships were noted related to SES and breakfast or fruit consumption among male adolescents (Pitel et al., 2013). Interestingly, although a study found female nutritional knowledge scores to increase as education level increased for both the father (60% to 64%, p<0.0069) and mother (58% to 64%, p<0.0128) (Sichert-Hellert et al., 2011), another found only maternal education to impact female nutritional knowledge scores (Bau et al., 2011). Higher maternal education was also found to be associated with healthier adolescent dietary behaviour's (measured by KIDMED) and a higher nutritional knowledge score for both males and females (p<0.05), however, the father's education was found to have no significant impact (Sahingoz & Sanlier, 2011).

Overall, female adolescents experienced a higher influence on their behaviour from their parents, in particular their mother. One study found that sex differences had greater influence than any other categorical influences on health behaviour, with "unfavorable food frequency" scores, food frequency scores in the lower 25th percentile, higher for adolescent females from homes where the mother had less than grade 10 (OR 3.3, CI 1.7-6.2, p<0.001) compared to those with grade 10 high school-leaving certificate, however no significant relationship was found

between the fathers education and female adolescent food frequency scores (Bau et al., 2011, p.1763).

Maternal employment was also found to negatively impact female adolescent dietary behaviour. Females who had mothers not in paid employment were more likely to decrease their snacking over a 2-year period ($p \leq 0.05$) and were less likely to increase their fast-food consumption ($p \leq 0.05$) as compared to those who had mothers in full time employment (Pearson at al., 2009). Additionally, in another study the presence of a mother at home improved healthy eating index scores for females ($p < 0.01$) but had no statistical impact on males (Park et al., 2013). Although females living in neighborhoods with a high density of supermarkets and fast-food outlets were more likely to be obese compared to females living in less dense neighborhoods (OR 1.03, CI 1.01-1.05, $p < 0.01$), the maternal employment status (not working outside the home) neutralized the effect high density neighborhoods had on females, resulting in a higher healthy eating index score ($p < 0.01$), however there was no statistically significant affect for males (Park et al., 2013). Instead, males in the same neighborhoods likelihood of being obese was linked to the economic status of the neighborhood; males in low SES neighborhoods had higher odds of obesity compared to males living in higher SES neighborhoods (OR 1.37, CI 1.06-1.76, $p < 0.01$) (Park et al., 2013).

Household composition influenced the dietary behaviours of males and females differently. Males who came from dual parent homes were less likely to consume low quantities of fruits and vegetables ($p \leq 0.05$), whereas females were more likely to consume higher quantities of fruits and vegetables and snack less frequently (Pearson at al., 2009). The presence of a brother at home impacted the eating habits of both males and females; males were more

likely to have low consumption of vegetables ($p \leq 0.05$), and females consumed breakfast more often ($p \leq 0.05$) (Pearson at al., 2009).

Barriers within the home and school environment were more frequently reported by females than by males, such as the lack of availability to healthy foods within the home and school setting (Ghasab et al., 2017; Gracey et al., 1996). When fruits and vegetables were 'always available' in the home, females were found to have higher FVC (median of 3.99) as compared to households where fruits and vegetables were 'sometimes or never available' (median 2.69) ($p<0.01$), however no statistical significance relationships were noted between males and home food environment (Hanson et al., 2004).

Household dietary behaviours impact females and males differently over the life span. A 20-year longitudinal study reported sex differences attributed to factors influencing dietary change (Lake et al., 2004). Both males (62%) and females (59%) identified their partners to significantly influence their diet, however 41% of males identified their partners as a positive influence compared to 29% of females ($p=0.015$), with only 3% of males identifying their partners as a negative influence compared to 15% of females ($p=0.015$) (Park et al., 2004). Although no statistical significance was found between sexes attributed to the influence that their parents had on their present dietary behaviours, 47% of females perceived their parental dietary habits in their youth to continue to impact their nutritional behaviours 20 years later (32% positively), compared to compared to 38% of males (27% positively) (Lake et al., 2004). Additionally, in a cross-sectional study on adolescent's parental dietary behaviour impacted males and females differently (Hanson et al., 2004). Parental consumption of four or more servings a day of fruits and vegetables compared to those who consumed less than one, was associated with increased FVC in females ($p<0.01$) but had no statistical impact on males

(Hanson et al., 2004). However, higher parental consumption of dairy, four or more servings per day compared to less than one, increased dairy consumption in males ($p<0.01$), but had no statistical impact on the intake of females (Hanson et al., 2004).

Studies referred to study participants as boys or girls, male or female, mothers or fathers, and gender identity was not identified or discussed. However, it should be noted that "the language related to gender identity and sexual orientation has …evolved rapidly" (American Psychological Association [APA], 2020, p.138), and since the majority of the included studies were published prior to the APA 7th edition, no study used bias free language. It is not evident if those that identified as male or female, boys or girls, reported their sex assigned at birth or current sexual orientation. The terms male and female, and not boys or girls, are used to refer to sex in the present study, however the complexity related to these terms as mentioned above remains, as does the potential for bias.

Age

Food skills have been found to increase with age; a secondary analysis of two observation studies found that the older group of participants as compared to the younger group used food media more (23.1% vs 0%), practiced more plating (46.2% vs 16.7%), and showed more food preparation behaviours, such as washing and peeling produce (30.8% vs 0%) and measuring ingredients (23.1% vs 5.6%) (Raber et al., 2018 et al.). Additionally, nutritional knowledge in adolescents was found to grow by 2% per year, by age of respondents in a cross-sectional study (Sichert-Hellert et al., 2011). However, despite these positive changes with increasing age, adolescents were also noted to participate less frequently in family meals (Utter et al., 2013) and skip breakfast more often ($p<0.001$) (Videon & Manning, 2003). The impact of increasing age is difficult to study due to the lack of longitudinal studies. This literature review only found two

studies that were longitudinal in nature, both were prospective cohort study, and discussed changes in dietary behaviour in participants at two different ages, one on 20 years (Lake et al., 2004) and one in two years (Pearson et al., 2009).

Summary

Themes within the literature in relation to sex, age, individual food literacy attributes and SES. Food literacy is a relatively new concept, with the definition identified to guide this review first developed in 2014 (Vidgen & Gallegos, 2014) and the guiding framework in 2017 (Azevedo Perry et al., 2017), later revised in 2019 (Thomas et al., 2019). Since this review encompasses articles dating back to 1996, it is not surprising that the vast majority of articles do not include all food literacy characteristics, and the definitions of food literacy and measurements of each attribute differ. As a collection of interrelated and multifaceted characteristics (Thomas et al., 2019), few studies, including more recent studies, were able to encompass the full complexity of food literacy, making it difficult to directly associate food literacy with dietary behaviour. Additionally, the wider contextual factors captured in the ecological attributes of food literacy vary in measurement and definition between the studies. Despite the challenges associated with the lack of consistency between definitions and measurements, the individual characteristics and attributes that comprise food literacy have been shown to impact adolescent dietary behaviour.

Programs successful in changing dietary behaviours and increasing self-efficacy and confidence incorporated food skills into their interventions (Bailey et al., 2019; Brooks & Begley, 2014; Vaitkeviciute et al., 2014). Most studies measured confidence from the perspectives of the adolescent, whether they felt they had sufficient knowledge or skill in a specific area (Lai Yeoung, 2010; Ronto et al., 2016), compared to an assessment of food literacy related skills. Performance is difficult to measure from cross-sectional questionnaires, as they

were often conducted in convenient settings such as schools and health clinics. A gap identified in this review is the absence of studies that assess the ability of an adolescent to perform food skills, and how this performance related to dietary behaviour. Future studies may benefit from evaluating food literacy attributes pre- and post-intervention and incorporating assessments of activities such as cooking and shopping. Considering programs that include food skills within their intervention report a higher success rate in changing behaviour, the investigation into the impact food skills have on dietary behaviours warrant further exploration.

Programs where interventions aimed to increase nutritional knowledge or to evaluate the impact of nutritional knowledge on dietary behaviours resulted in inconsistent dietary change. Nutritional knowledge levels were impacted by SES, measured by household education levels and household income, adolescents from homes with higher SES exhibited greater nutritional knowledge (Fleary et al., 2018; Sahingoz & Sanlier, 2011; Sichert-Hellert, 2011) and healthier dietary behaviour (Bau et al., 2011; Fleary et al., 2018; Ghasab et al., 2017; Gracey et al., 1996; Park et al., 2013; Pearson et al., 2009; Pitel et al., 2013; Videon & Manning, 2003). The evidence is not clear whether nutritional knowledge or SES had a greater impact on dietary behaviours.

Socio-economic status and learning environments had a significant impact on the dietary behaviours of adolescents. Higher SES measured by education or income impacted dietary behaviour positively (Bau et al., 2011; Fleary et al., 2018; Ghasab et al., 2017; Gracey et al., 1996; Nagy-Pénzes et al., 2020; Park et al., 2013; Pearson et al., 2009; Pitel et al., 2013; Videon & Manning, 2003). The most cited barrier to healthy eating was the availability of healthy food options within the home or school setting (Ghasab et al., 2017; Gracey et al., 1996; Hanson et al., 2004). The availability of healthy and unhealthy foods within the home or neighbourhood

impacted adolescent dietary behaviours (Park et al., 2013), as when unhealthy foods were available, they were chosen over healthy options. Additionally, as SES declined, other risk behaviours increased and were generally associated with more unhealthy dietary behaviour (Fleary et al., 2018; Gracey et al., 1996).

Food literacy attributes occur and impact dietary behaviour differently between males and females. Most studies found that female adolescents had higher nutritional knowledge (Bailey et al., 2019; Ghasab et al., 2017; Gracey et al., 1996; Sichert-Hellert et al., 2011; Vaitkeviciute et al., 2014) and FVC (Bailey et al., 2019; Ghasab et al., 2013; Nagy-Pénzes et al., 2020; Park et al., 2013; Ronto et al., 2016; Sahingoz & Sanlier, 2011; Souza Santos et al., 2019) as compared to their male counterparts. However, these traits were not consistently attributed to healthier diet behaviour, as more female adolescents skipped meals (Garrido-Ferández et al., 2020; Ghasab et al., 2013; Nagy-Pénzes et al., 2020; Park et al., 2013; Pearson et al., 2009; Vaitkeviciute et al., 2014; Videon & Manning, 2003) and were either just as likely or more likely to practice poor dietary behaviours as compared to males (Lai Yeung 2010; Park et al., 2013; Sanchez et al., 2007; Sichert-Hellert et al., 2011). Ecological factors also influence females differently than males, such as household education, which was found to impact the nutritional knowledge scores of female adolescents more than males. However, when household education was evaluated by sex, maternal education had the greatest impact on the dietary behaviours of both sexes of adolescents (Bau et al., 2011; Pearson et al., 2009; Sachingoz & Sanlier, 2011).

Food and nutritional knowledge increased by approximately 2% a year with respect to the age of survey respondents (Sichert-Hellert et al., 2011), yet dietary behaviours were poorer (Pearson et al., 2009; Videon & Manning, 2003), possibly attributed to changing ecological influences, with the home environment reported to have a lower influence in older adolescents

and social acceptability having a higher influence (Tarabashkina et al., 2016). Due to lack of longitudinal studies and a lack of attention to development age within primary studies, the impact age has on food literacy and dietary behaviours is difficult to assess.

Strengths and Limitations of Review

This review was based on a systematic methodological framework, study question and key terms guided by the PIE model, it followed the PRISMA reporting guidelines, and the search terms and analysis were guided by the food literacy framework developed by Thomas et al. (2019).

A limitation of this review is that it only includes peer reviewed literature; a search was not conducted for grey literature and as an emerging concept this methodology did not prioritize inclusion of government papers describing population health initiatives that aim to improve population food literacy. A second limitation, which is also reported in food literacy knowledge synthesis studies (Bailey et al., 2019; Brooks & Begley, 2014), is that definitions, and conceptualizations of the attributes of food literacy differ between studies, making it difficult to establish concrete search terms, resulting in a broad range of studies and difficulty in establishing definitive conclusions. A third limitation relates to potential response bias within the studies that measure food literacy attributes based on surveys, questionnaires, or 24-hour recall, reported by the respondent (n=22/28). Although the majority of these studies employed strategies to reduce bias such as anonymous data collection and randomization strategies, the potential remains for bias based on socially desirable responses and limit the introduction of new concept development encouraged through open ended questions. Studies, such as Raber et al. (2018) that reviewed observational data related to dietary behaviour show potential to limit recall and social

desirability bias, as well as mixed methodology studies such as Ronto et al (2016) where focus groups allow for the exploration of emerging themes.

Conclusion

This literature review described the current state of the knowledge related to the relationships between adolescent food literacy and dietary behaviours. The review identified that food skills remain an underexplored attribute of food literacy and those interventions aiming to change dietary behaviours should consider the incorporation of food skills within their programs. However, SES and the availability of healthy food options within the home significantly impact the ability of adolescents to develop food literacy and healthy dietary behaviours.

During study selection, there were limited studies that evaluated food literacy from the perspective of the adolescent, resulting in merely 28 of 2,235 non duplicate citations being included in the present review, of which only 5 touched on each food literacy heading within the food literacy framework (Table 3). The 2013 Canadian community health survey (CCHS) rapid response on food skills (Part 2) – mechanical skills and food conceptualization (FS2) is a comprehensive data set that includes questions related to food skills that incorporate nutritional knowledge and self-efficacy, as well as data associated with ecological attributes. This data set offers an opportunity to further examine the impact food skills have on adolescent dietary behaviours. Fruit and vegetable consumption represent a rational outcome variable to measure healthy dietary food choices among adolescents, as it was the most commonly measured dietary behaviour outcome among the primary studies (16/22 primary studies) included in this review (Bau et al., 2011; Chartatos et al., 2018; Hanson et al., 2004; Lai Yeung, 2010; Nagy-Pénzes et al., 2020; Orehek & Ferrer, 2018; Park et al., 2013; Pearson at al., 2009; Pitel et al., 2013; Raber et al., 2018; Ronto et al., 2016; Sanchez et al., 2007; Souza Santos et al., 2019; Utter et al., 2013;

Videon & Manning, 2003). Thus, the purpose of the proposed research project is to conduct a secondary analysis of the CCHS rapid response on FS2 to answer the research question, how does food literacy affect FVC among Canadian adolescents?

Chapter 3: Methods

Data for the present research was obtained from a secondary analysis of the 2013 Canadian Community Health Survey (CCHS) Rapid Response on Food Skills (Part 2) – mechanical skills and food conceptualization (FS2). A descriptive research design was employed to describe the relationships between food literacy attributes of Canadian adolescents and FVC. The data source, study design, sample population, variable selection, and employed statistical analysis will be discussed in the following chapter.

Rapid Response on Food Skills (Part 2) – Mechanical Skills and Food Conceptualization Data Set

The Rapid Response on Food Skills (Part 2) – mechanical skills and food conceptualization is a continuation of the rapid response on food skills part 1 - knowledge, planning and transference of skills (Statistics Canada, 2013b). Each rapid response module is independent of the other and can be asked separately (Statistics Canada, 2013b). Rapid response surveys aim to obtain national estimates on an emerging or specific topic related to population health (Statistics Canada, 2013a). The CCHS rapid response survey takes a maximum of two minutes per interviewee and questions are asked of all CCHS respondents during a single collection period of two months (Statistics Canada, 2013a). The survey was developed in collaboration with specialists from Statistics Canada, federal and provincial departments and/ or academic fields for computer assisted interviewing (CAI) (Statistics Canada, 2013a). The survey was field tested prior to CCHS data collection for observation of respondent reaction to the survey, time estimates for various sections, study response rates, and to test feedback questions (Statistics Canada, 2013a).

The CCHS is an annual cross-sectional survey that targets a sample size of 65,000 respondents through a multi-stage sample allocation strategy (Statistics Canada, 2013a). To

control for potential volunteer bias, the CCHS employs controlled randomization sampling strategies. Sample populations over the age of 18 years are selected using selection probabilities within an area frame method that gives relatively equal importance proportionally to the populations residing in 110 health regions (HR) and 10 provinces, excluding populations living in the Territories, on Aboriginal reserves or settlements, within foster care, institutions, and full-time members of the Canadian Forces. (Statistics Canada, 2013a). Aboriginal is the term used to refer to people who "are usually those with ancestors who resided in North America prior to European contact and who identify with one of the three Aboriginal groups listed on the questionnaire: First Nations (North American Indian), Métis and Inuk." (Statistics Canada, 2013c, p.73). Sample populations between the age of 12 and 17 years are selected by using the Canadian Child Tax Benefit Frame, one child per household is selected to complete the survey (Statistics Canada, 2013a). To minimize sampling errors, CCHS uses highly skilled and trained interviewers (Statistics Canada, 2013a). Missing data related to partial completion was reported as minimal, with the majority of missing data or non-response occurrences classified as a "total non-response", described as a selected respondent who refused to be interviewed or by the inability of the interviewer to contact the selected respondent (Statistics Canada, 2013a). Missing data attributed to "total non-response" were handled by adjusting the weight of persons who responded to the survey based on the characteristics available for both the respondents and non-respondents (Statistics Canada, 2013a).

Once a household had been selected, all members of the household are listed and all persons over the age of 12 are recorded. Through various probabilities based on age and household composition, one person from the household is selected to participate in the survey (Statistics Canada, 2013a). Approximately 40% of the CCHS interviews are conducted using

computer assisted personal interviewing (CAPI) and 60% are over the phone using computer assisted telephone interviewing (CATI) (Statistics Canada, 2013a). Strengths of computer assisted interviewing (CAI) include a case management and data transmission functionality, as well as the ability to customize interviews to the respondent's characteristics and survey responses, providing immediate feedback and edits to check for inconsistent answers (Statistics Canada, 2013a). Interviews are conducted by an interviewer who is competent in the language primarily spoken by the respondent (Statistics Canada, 2013a).

Responding to the survey is voluntary and data is collected directly from the respondents (Statistics Canada, 2013a). In 2013, 61,103 individuals completed the CCHS survey, a response rate of 67.0% (Statistics Canada, 2013a). In January and February of 2013, 15,723 respondents were determined to be within the scope for the Food Skills (Part 2) rapid response, of which 12,072 households agreed to participate, with 10,701 individuals completing the survey, representing a combined response rate of 68.1% (Statistics Canada, 2013b).

Rapid response sample weights are "calibrated by province by age group by sex, instead of the usual Health region by age group by sex" (Statistics Canada, 2013b, p.2). Due to the smaller sample sizes of the rapid response survey, it can be difficult to obtain high quality estimates at a detailed level, hence the recommendation by Statistics Canada to create national level estimates, or depending on sample size, provincial level estimates (Statistics Canada, 2013b). In consideration of the above recommendation, analysis was only conducted on bootstrapped[1] results to ensure the quality of the sampling distribution was representative of the

[1] Bootstrapping methods are procedures "that provide alternative ways to estimate the variance and standard error of a parameter by repeated resampling from a sample. Bootstrapping is a nonparametric approach to statistical inference that can be applied to any data because it required no assumptions about underlying population distributions. ... "This resampling provides an estimate of what we would have gotten had we sampled repeatedly from the population" (Vogt & Johnson, 2011, p.36).

overall population. Bootstrapping was employed to calculate percentages, standard error, confidence intervals and coefficients of variation, and to test statistical significance of differences.

Cross-sectional studies, such as the CCHS, collect large volume of data, and are useful for calculating prevalence rates, recognizing trends and patterns, and serving as preliminary data to support subsequent, more extensive research (Thompson & Panacek, 2006). The analysis of national cross-sectional data collected in the CCHS FS2 was utilized to describe the prevalence of food literacy characteristics within the Canadian adolescent population and the patterns or relationships between the identified variables.

A request to access the confidential Master Data File for the 2013 CCHS Rapid Response on Food Skills (part 2) – Mechanical skills and food conceptualization was made to Statistics Canada for access to the regional data center (RDC) program; approval was received October 15, 2019. All analyses were conducted in and vetted through the RDC, as the CCHS FS2 is not available as a Public Use Microdata Files (PUMF).

Sample Population

The study sample was drawn from households where adolescents aged 12 to 17 years of age were selected as survey respondents. Only survey respondents who answered the questions related to the dependent variable, total daily fruit and vegetable consumption (FVCGTOT), were included. Responses to questions pertaining to highest level of household education attainment, total household income, and geographical location (Province of residence) were answered by the person most knowledgeable (PMK) in the household, and not the adolescent respondent selected for the survey.

Variable Selection

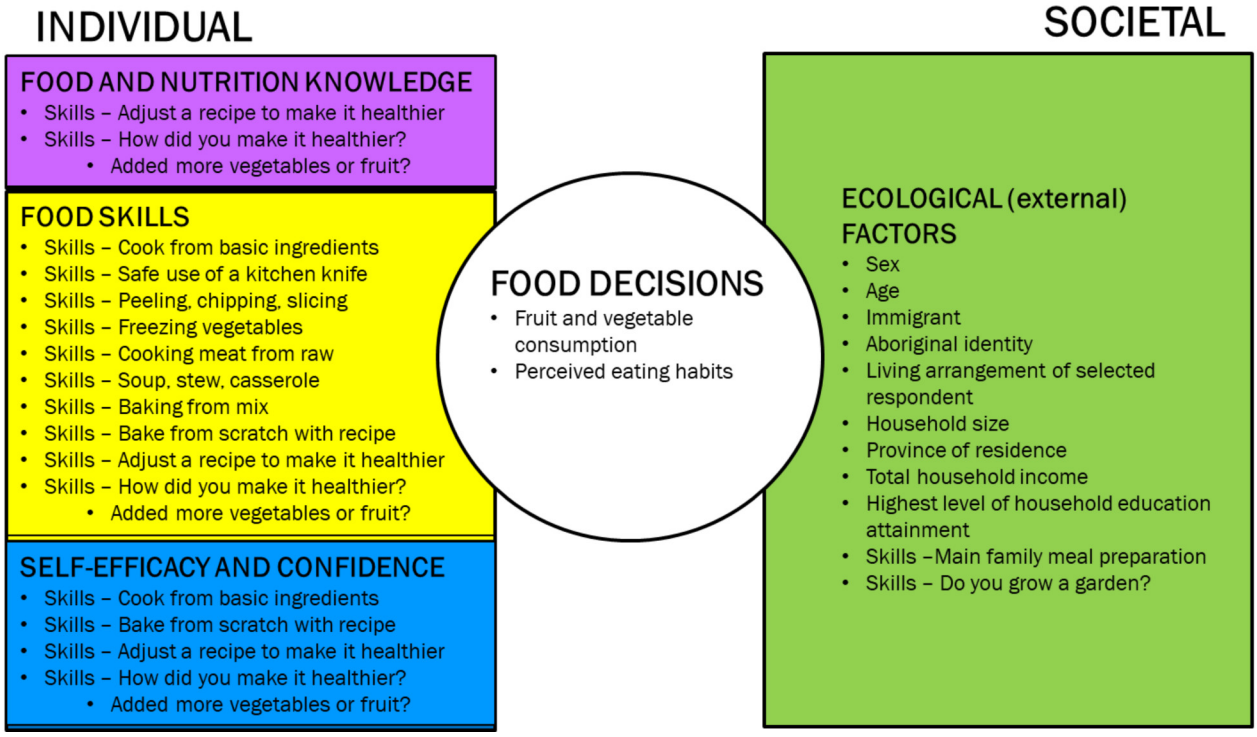
The food literacy framework by Thomas et al. (2019) was used to guide the variable selection and analysis. Figure 4 displays the food literacy framework and the selected survey variables that aligned with each food literacy category. A complete list of study variables is available in Appendix D. The CCHS FS2 was chosen for secondary analysis as it contains questions pertaining to food skills that are reflective of food literacy attributes identified by Thomas et al (2019). For example, questions that assess the individual characteristics of nutritional knowledge, self-efficacy and food skills are reflected in questions related to the respondent's ability to use a knife or peel vegetables, to cook from basic whole ingredients versus ready to eat and take-out options, to follow a recipe, or to adjust a recipe to make it healthier. Dietary behaviour was assessed through questions pertaining to FVC and perceived eating habits. The societal category (the meso-and macrosystem that interact with food decisions) included variables assessing household socio-economic attributes, or SDH, including highest level of household education attainment, total household income, and household composition. Age, sex, immigration status, and survey respondents who identify as Aboriginal, represent both population characteristics and SDH (CPHA, 2021; Office of Disease Prevention and Health Promotion 2021) which are captured under the societal/ external factors. However, the Aboriginal population identified within this survey are only representative of the survey respondent's who self identify as Aboriginal, and do not represent the larger Canadian Aboriginal population.

Provincial residency was included to allowed for the comparison of variances and similarities between provinces. Additional variables possibly associated with food literacy were body mass index (BMI) and perceived health status (Vaitkevičiūtė & Petrauskienė, 2019.

Specifically, BMI has been negatively associated with nutrition and healthy dietary behaviours in some studies (Vaitkevičiūtė & Petrauskienė, 2019), while perceived health status may influence food skills activities and dietary behaviours.

Figure 4

Study Variables From Canadian Community Health Survey - Rapid Response on Food Skills (Part 2) – Mechanical Skills and Food Conceptualization Data Set That Align With Categories From the Food Literacy Framework by Thomas et al., 2019.



Note. Food literacy table adapted from "Complexities in conceptualizing and measuring food literacy" by H. Thomas et al., 2019, Journal of the Academy of Nutrition and Dietetics, 119(4), 563-573. Variables represented in table are from the "Canadian Community the Health Survey, Rapid Response on Food Skills (Part 2) – mechanical skills and food conceptualization, data set" (Statistics Canada, 2013).

Statistical Analysis

Statistical analysis was conducted in SPSS (version 24) (IBM Corp., 2013) and STATA (version 15) (Stata Corp, 2015) software. SPSS was used to apply the inclusion criteria for age and to prepare the data for analysis. The data file was then merged with the bootstrapping and master weights files and exported into STATA to allow data analysis to be conducted with

bootstrapped weights applied. Bootstrapping was employed to estimate distribution, to calculate confidence intervals and coefficients of variation, and to test the statistical significance of differences for all data analyses. The employment of bootstrapping procedures is intended to allow for probability-based estimation of the population distribution from the survey data, by applying an empirical technique "to estimate the variance and standard error of a parameter by repeated resampling of a sample" (Vogt & Johnson, 2011, p.36). A significance level of $p<0.05$ was applied to all cases. The data analyses involved both descriptive and inferential statistical tests. The relationships between independent and dependent variables were analysed through correlational and regression statistical tests. The study used a non-experimental, descriptive correlational research design. A descriptive research design was chosen as the study does not involve the employment of an intervention, rather the intent was to describe relationships between variables previously collected. This research design aligns with the study's aim to describe the relationship between food literacy attributes of Canadian adolescents aged 12 to 17 years and FVC using cross-sectional data collected in 2013.

Descriptive Analysis

Univariate statistical analysis described the study population and selected variables numerically as percentages, numbers, and mean values. Variability within the data was described by standard deviation.

Bivariate descriptive analysis between independent and dependent data were analyzed using cross-tabulations, chi square, and simple logistic regression. The dependent variable was a binary variable measuring the frequency of FVC daily, less than 5 times (FVC=0) and 5 times or more (FVC=1), created from the variable FVCGTOT. The selection of FVC as an outcome variable to measure healthy dietary behaviours is supported by the WHO (2020) obesity

prevention recommendations, which amongst several strategies, calls for increased adolescent FVC. Consuming fruit or vegetables five or more times a day was selected as a measure of healthy food behaviours for three reasons. First, a minimum intake of five servings of fruits and vegetables per day is widely referenced in the literature as the recommended minimum intake if fruits and vegetables internationally (Roark & Niederhauser, 2012), and approaches the recommendations of Health Canada for daily servings of fruit and vegetable intake the year the CCHS survey was conducted; seven to ten for adults, six for children aged 9-13, and seven to eight for children aged 14-18 (Health Canada, 2019). Secondly, FVC was the most commonly measured dietary behaviour outcome found within this studies literature review (Bau et al., 2011; Chartatos et al., 2018; Hanson et al., 2004; Lai Yeung, 2010; Nagy-Pénzes et al., 2020; Orehek & Ferrer, 2018; Park et al., 2013; Pearson at al., 2009; Pitel et al., 2013; Raber et al., 2018; Ronto et al., 2016; Sanchez et al., 2007; Souza Santos et al., 2019; Utter et al., 2013; Videon & Manning, 2003). Thirdly, the data collected in the survey used for this study has recorded fruit and vegetable intake as less than five times a day, five to ten times a day, and more than 10 times a day.

Results were reported as percentages and p values, which were derived from chi square analysis, and odds ratios from simple logistic regression analysis. Assumptions for the chi square tests and simple logistic regression models of *n* quota were evaluated within the RDC based on the non-bootstrapped sample. When variables failed to meet the assumption of *n,* they were recoded until the assumption for *n* was met. The most appropriate variable categories were recoded based on clinical applicability of the existing categories to meet the *n* quota. Variable categories titled ‘don’t know’, ‘refused’, or ‘not stated’, were recoded as ‘missing’ data, and

while included in the description of the population, missing data were not included in the chi square or logistic regression models.

Logistic regression models were examined for multicollinearity among included variables. Variables that were significant at the bivariate level were considered for inclusion at the multivariate model level, and in some cases non-significant variables were also included as possible predictors if they were significant within the literature or based on clinical experience. Covariates identified within the literature were selected based on significant relationships to food literacy and adolescent FVC, including sex and highest level of household education attainment. Although total household income had statistically significant relationships to adolescent FVC at the bivariate level, it was not selected as a covariate at the multivariate level due to the lack of consistency as a predictor of SES within the literature. Within the literature, income was most frequently used as a measure of SES in combination with household education, rather than as an independent variable (Bau et al., 2011; Hanson et al., 2004; Nagy-Pénzes et al., 2020; Sichert-Hellert et al., 2011; Souza Santos et al., 2019). Additionally, income as a variable may not be representative of SES due to cost of living variations geographically across Canada, which cannot be controlled for with the level of geographical data available within the CCHS FS2. Despite the sample being bootstrapped, the actual samples (*n*) in less populated provinces are low, thus data pertaining to provincial populations should be used with caution and may not be generalizable to the populations of these regions. Additionally, provincial data is not broken down by urban verses rural, or by the socioeconomics of neighbourhoods or regions, as such it is difficult to ascertain the ecological or environmental impact that provincial geography has on FVC of Canadian adolescents. To account for the aforementioned concerns related to provincial samples, the variable geo_prov was removed from the final model. The variable adding

vegetables to a recipe to make it healthier was also removed from the multi logistic regression models due to multicollinearity concerns associated with the variable adjusting a recipe to make it healthier', which was retained in the final model.

Multivariate Analysis

Logistic regression was selected to analyse the relationship between food literacy variables and FVC, as this type of analysis allows for the use of both categorical and continuous independent variables within the analysis, thereby expanding the number of independent variables to be analysed. The final logistic model was developed from variables that had a statistically significant relationship to FVC at the bivariate level. Variables not showing statistical significance at the bivariate level were considered for inclusion if identified within the literature or clinical practice as important, such as sex.

The goodness of fit test, estat gof postestimation command for the Hosmer-Lemeshow goodness-of-fit test statistic, was reported as an indicator of explanatory power for the final logistic regression model (Xing, 2016). Although the use of data sets containing large samples, such as the Statistics Canada survey data, "is thought to mitigate concerns about potential influential observations by minimizing the contribution of any given observation", influential outliers can still arise in these large samples (Ryan et al., 2015, p.4). The required diagnostic statistics through STATA to identify the confidence interval displacement diagnostic (C diagnostic) and the DFbeta diagnostic (the standardized difference in the parameter estimate due to deleting given observations) are not available for bootstrapped data, therefore it has been recommended to assess the final model for outliers, leverage, and influence (Ryan et al., 2015; Zhang, 2016). Influential observation analysis was conducted on the model. Multivariate outliers were identified, and the model was run again excluding these individuals. The results were

assessed for changes in the sign or direction of the odds ratios or changes in significance. No significant shift of the coefficient greater than 14%, nor change in significance of included variables were observed, therefore all cases were left in the final model.

Chapter 4 – Results

An overview of the study sample, including food literacy individual characteristics and societal/ external food literacy factors are provided in Chapter 4. The differences between the likelihood of study variables predicting FVC in Canadian adolescents are also discussed. Finally, the results of the logistic regression model will be discussed. Study results specify whether the reported N values are representative of the non-bootstrapped or the weighted bootstrapped sample. The reported statistical measures, including percentages, p values, and odds ratios are representative of the weighted bootstrapped data analyses run in STATA.

Study Sample Characteristics

Data from 790 Canadian adolescent (age 14.7 ±0.14 years; range 12-17 years) were included in the current analysis. This population was drawn from 896 households where adolescents aged 12 to 17 years of age were selected and responded to the 2013 CCHS FS2. Sample characteristics are shown in Table 4. All data are reflective of answers provided directly by the adolescent selected for the survey, unless indicated that the question was answered by the person most knowledgeable (PMK) within a household.

Table 4

Descriptive Characteristics of Study Sample, Canadians, 12 to 17 Years of Age, Canadian Community Health Survey – Rapid Response on Food Skills (Part 2) – Mechanical Skills and Food Conceptualization 2013 (N=790), (Weighted N=2,127,482).

Descriptive sample variables	Total population weighted sample 100%	Weighted N=2,127,482	Non weighted sample N=790
Sex			
Male	50.2	1,067,145	409
Female	49.8	1,060,337	381
Age			
12	13.8	293,380	112
13	13.2	279,977	124
14	18.6	395,073	138
15	19.7	419,965	142
16	18.4	390,818	137
17	16.4	348,269	137
Immigration status of adolescent			
Country of birth outside of Canada	12.5	265,510	68
Born in Canada	86.5	1,841,123	714
Missing	1.0	20,888	8
Aboriginal identity (Self identified)			
Aboriginal (First nations, Metis, Inuit)	5.1	107,800	66
Not Aboriginal	81.1	1,725,175	640
Not applicable [a]	12.5	265,084	68
Missing	1.4	29,529	16
Living arrangements of adolescent respondent			
Not living with parent	10.5	224,237	84
Living with single parent	20.4	434,645	136
Living with 2 parents	68.5	1,458,176	565
Missing	0.5	10,697	5
Self-perceived health			
Very good to excellent	68.2	1,451,368	554
Poor, fair, or good	31.8	676,114	236
Missing	0.0	0	0
Respondents' opinion of own weight (self reported)			

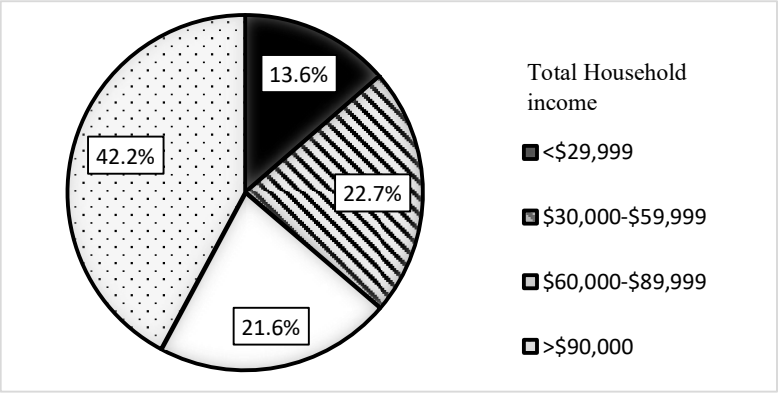
Just about Right	73.5	1,564,338	592
Under or over weight	21.3	453,579	153
Missing	5.2	109,736	45
Body mass index (self-reported)			
Neither overweight nor obese	71.6	1,522,852	539
Overweight/ obese	19.3	410,179	170
Missing	9.1	194,409	81
Fruit and vegetable consumption			
Less than 5 time a day	56.4	1,200,751	436
5 or more times a day	43.6	926,731	354
Eating habits			
Very good to excellent	45.7	972,898	381
Poor, fair, or good	52.5	1,116,928	396
Missing	1.8	37,742	13
Province of residence of respondent (PMK)			
Newfoundland and Labrador	1.7	35,252	28
Prince Edward Island	0.5	11,284	15
Nova Scotia	2.9	62,399	31
New Brunswick	2.1	43,933	29
Quebec	21.3	453,366	128
Ontario	40.5	861,843	318
Manitoba	3.3	70,441	39
Saskatchewan	2.8	59,910	36
Alberta	11.4	242,107	78
British Columbia	13.5	286,997	88

Note: Percentage values are representative of bootstrapped data. PMK= person most knowledgeable in household. [a] Adolescent respondent born outside Canada, US, Germany, and Greenland.

The study sample represents a bootstrapped sample of 2,127,482 of the Canadian national population aged 12 through 17. Statistics Canada weights data at the person-level to ensure weights sum up to known population totals, calibrated by province, age group, and by sex (Statistics Canada, 2013b). The weighted sample was comprised of 50.2% male and 49.8% female, and more than half of the respondents lived in homes with two parents (68.5%), while 20.4% lived in single parent households, and 10.5% reported not living with a parent. A higher percentage of study respondents came from households reporting higher annual incomes, 42.2% from households with income greater than $90,000, compared to 13.6% from households with incomes less than $29,999 (Figure 5). A higher percent of respondents came from households with higher education; 37.2% were from households where the highest level of household educational attainment was a bachelor's degree or higher, compared to 16.8% from households where the highest level of household educational attainment was high school graduation (Figure 5).

Figure 5

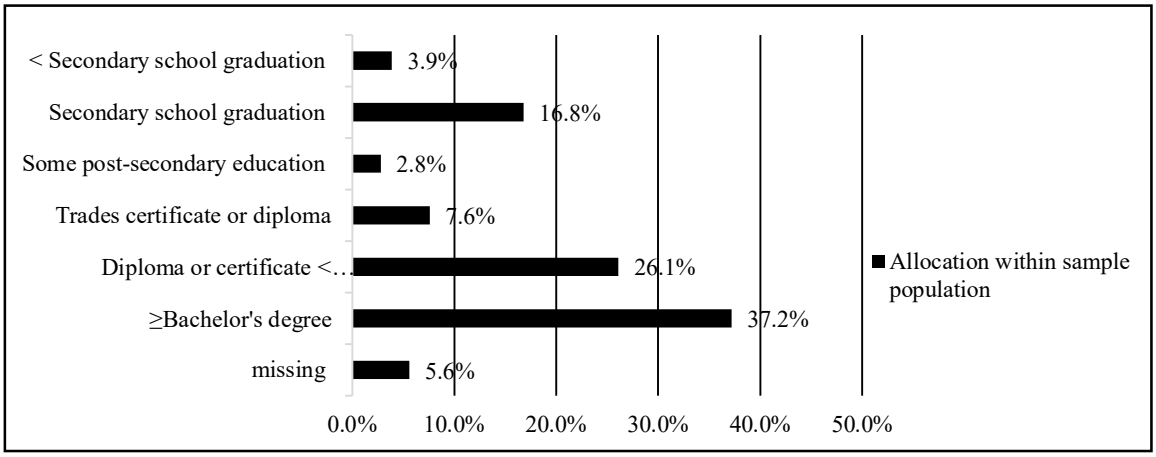
Distribution of Total Household Income From all Sources, Canadians, 12 to 17 Years of Age, Canadian Community Health Survey – Rapid Response on Food Skills (Part 2) – Mechanical Skills and Food Conceptualization 2013 (N=790).



Note. All dollars are in Canadian currency.

Figure 6

Highest Level of Household Educational Attainment, Canadians, 12 to 17 Years of Age, Canadian Community Health Survey – Rapid Response on Food Skills (Part 2) – Mechanical Skills and Food Conceptualization 2013 (N=790).



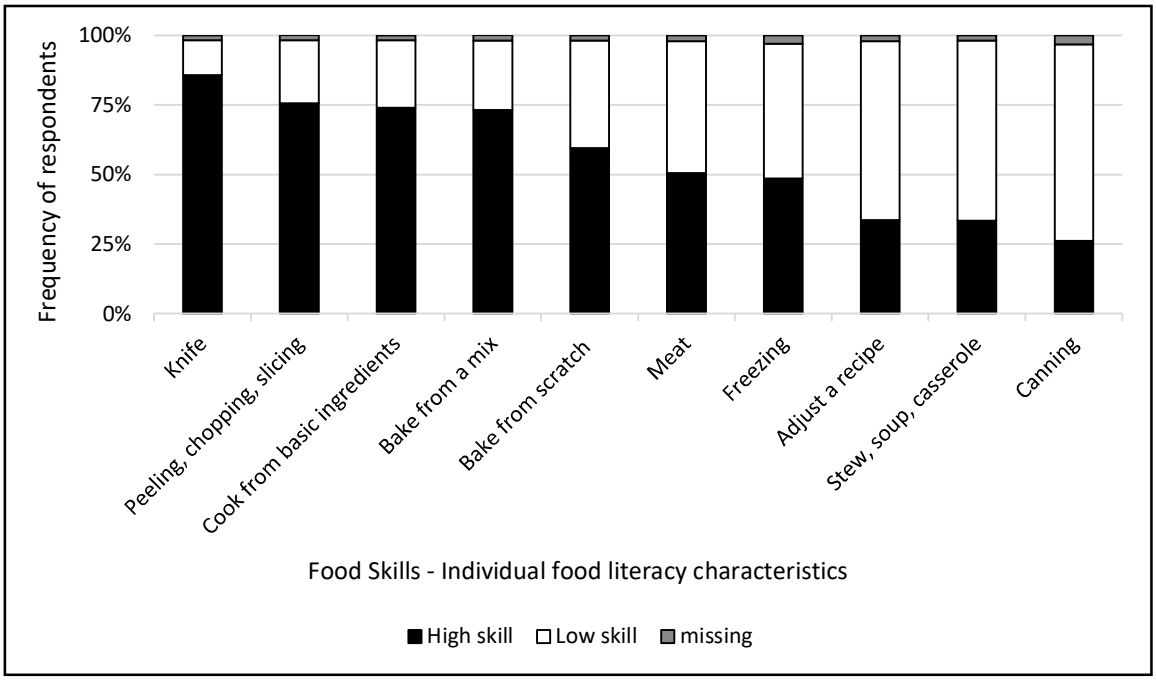
Approximately two thirds of respondents reported their health as very good or excellent (68.2%), compared to those who reported their health as poor, fair, or good (31.8%). Similarly, approximately three quarters of respondents reported their opinion of their weight as just about right (73.5%), compared to those who reported their weight as under or over (21.3%). Even though the demographic description in Table 4 shows the respondent's opinion of their weight as just about right closely aligned with the percentage of respondents who were neither overweight nor obese (71.6%) as measured by the BMI, these two variables were not run for comparison purposes for each respondent to confirm alignment. Over half of respondents (56.4%) consumed fruits and vegetables less than five times a day. However, the mean FVC among the total sample population approaches consumption of fruits and vegetables five or more times, at 4.9 (±0.3) servings a day. Just under half of respondent's reported their eating habits as very good to excellent (45.7 %).

Study variables representing individual food literacy characteristics are displayed in Figure 7. As evident in figure 7, when food skills were more complex, a lower percent of

respondents reported high confidence in the skill. For example, while 85.6% of respondents reported high confidence in the safe use of a knife, only 48.6% reported high confidence in their ability to freeze raw vegetables, and 26.1% in their ability to can foods in glass jars. This pattern is also evident in a respondent's ability to prepare food, were as food preparation variables become increasingly complex and require a higher level of food and nutritional knowledge, fewer respondents report high levels of skill. For example, while nearly three quarters of respondents reported high confidence in their ability to bake from a mix (73.2%), only 59.5% of respondents reported high confidence in their ability to bake from scratch, and about a third (33.6%) reported high confidence in their ability to adjust a recipe to make it heathier.

Figure 7

Sample Variables Descriptive of Individual Food Literacy Characteristics, Canadians, 12 to 17 Years of Age, Canadian Community Health Survey – Rapid Response on Food Skills (Part 2) – Mechanical Skills and Food Conceptualization 2013 (N=790).



Differences Between Food Literacy Characteristics and Their Relationship to FVC

The relationships between the selected food literacy variables and the probability of consuming fruits and vegetables five or more times per day are displayed in Table 5. Independent variables were grouped under food literacy categories that best aligned with each variable; however, food literacy characteristics are interconnected and as such there are overlaps between categories where variables fit. Although the CCHS FS2 records total daily FVC as servings per day, it should be noted when interpreting results that this is a measurement of FVC as "the number of times (frequency), not the amount consumed" (Statistics Canada, 2013a, p.99).

Table 5

Sample Population Characteristics by Reported Fruit and Vegetable Consumption for Canadians, 12 to 17 Years of Age, Canadian Community Health Survey – Rapid Response on Food Skills (Part 2) – Mechanical Skills and Food Conceptualization 2013 (N=790).

	Fruit and vegetable consumption of 5 or more servings a day (FVC=1)	Fruit and vegetable consumption of less than 5 servings a day (FVC=0)	P value	Unadjusted odds ratio 95% CI	
	Weighted 100 % N=2,127,482	Weighted 100 % N=2,127,482			
Sex			0.2		
Male	47	53			Ref
Female	41	59		0.78	[0.52, 1.16]
Age			0.4		
12	42	58		1.22	[0.61, 2.41]
13	42	58		1.22	[0.60, 2.52]
14	54	46		2.03	[1.04, 3.95]
15	44	56		1.32	[0.68, 2.57]
16	41	59		1.18	[0.58, 2.39]
17	37	63			Ref
Self-Perceived health			0.03		
Very good to excellent	47	53		1.57	[1.05, 2.34]
Poor, fair, or good	36	64			Ref
Body mass index (self-reported)			0.2		
Neither overweight nor obese	46	54		1.33	[0.84, 2.11]
Overweight/ obese	39	61			Ref

Respondents' opinion of own weight (self reported)			0.006		
Just about right	48	52		2.03	[1.23, 3.37]
Under or over weight	31	69			Ref
Individual food literacy characteristics					
Skills-cooking from basic Ingredients			0.01		
High	47	53		1.84	[1.12, 3.02]
Low	33	67			Ref
Skills - Knife			0.6		
High	43	57		0.85	[0.46, 1.56]
Low	47	53			Ref
Skills - Peeling, chopping, slicing			0.2		
High	45	55		1.35	[0.84, 2.16]
Low	38	62			Ref
Skills - Freezing			0.05		
High	49	51		1.50	[1.00, 2.24]
Low	39	61			Ref
Skills – Canning			0.5		
High	47	53		1.16	[0.76, 1.78]
Low	43	57			Ref
Skills - Meat			0.2		
High	47	53		1.31	[0.88, 1.94]
Low	40	60			Ref
Skills -Stew, soup, casserole			0.1		
High	50	50		1.45	[0.98, 2.15]
Low	40	60			Ref
Skills - Baking from mix			0.4		
High	45	55		1.23	[0.73, 2.07]
Low	40	60			Ref
Skills-Bake from scratch, recipe			0.1		

High	47	53		1.36	[0.91, 2.05]
Low	39	61			Ref
Adjust a recipe, healthier			0.002		
Yes	55	45		2.05	[1.29, 3.26]
No	38	62			Ref
How did you make it healthier?					
Added more vegetables or fruit			0.8		
Yes	54	46		0.92	[0.45, 1.88]
No	56	44			Ref
Dietary behaviour					
Eating habits			<0.001		
Very good to excellent	59	41		3.34	[2.25, 4.95]
Poor, fair, or good	30	70			Ref
Societal characteristics					
Immigration Status of adolescent			0.1		
Country of birth reported outside of Canada	31	69			Ref
Born in Canada	45	55		1.85	[0.91, 3.78]
Aboriginal identity (Self identified)			0.1		
Aboriginal (First nations, Metis, Inuit)	48	52			Ref
Not Aboriginal	45	55		1.85	[0.42, 1.89]
Not applicable [a]	31	69		0.49	[0.19, 1.31]
Living arrangements of adolescent respondent			0.4		
Not living with parent	58	42			Ref
Living with single parent	62	38		0.86	[0.38, 1.94]
Living with 2 parents	54	46		1.19	[0.62, 2.29]
Income - Total household income from all sources (PMK)			0.02		
≤$29,999	52	48		1.11	[0.58, 2.13]
$30,000-$59,999	33	67		0.50	[0.30, 0.82]
$60,000-$89,999	39	61		0.64	[0.39, 1.07]

≥$90,000	49	51			Ref
Highest level of education – household, 6 types (PMK)			0.02		
Did not complete secondary school	65	35		2.05	[0.68, 6.11]
Completed secondary school	36	64		0.61	[0.31, 1.20]
Some post-secondary education	66	34		2.18	[0.50, 9.57]
Trade's certificate or diploma	23	77		0.34	[0.14, 0.81]
Diploma or certificate below a bachelor's degree	44	56		0.88	[0.55, 1.41]
Bachelor's degree or higher	48	52			Ref
Province of residence of respondent (PMK)			0.001		
Newfoundland and Labrador	30	70		0.79	[0.25, 2.48]
Prince Edward Island	50	50		1.85	[0.40, 8.55]
Nova Scotia	40	60		1.21	[0.42, 3.50]
New Brunswick	54	46		2.13	[0.71, 6.34]
Quebec	60	40		2.67	[1.32, 5.43]
Ontario	43	57		1.38	[0.75, 2.57]
Manitoba	16	84		0.35	[0.13, 0.95]
Saskatchewan	23	77		0.53	[0.15, 1.84]
Alberta	38	62		1.12	[0.55, 2.29]
British Columbia	36	64			Ref
Preparation of main meal			0.6		
Mostly whole foods	45	55		1.15	[0.72, 1.86]
Not mostly whole foods	41	59			Ref
Do you grow vegetables, herbs, or fruit at home or in a community garden			0.5		
Yes	45	55		1.14	[0.77, 1.69]
No	42	58			Ref

Note. Chi-square analyses (p values) are based on weighted data. Simple logistic regression analyses, odds ratios (ORs) and 95% confidence intervals (CIs) are based on weighted data. PMK= person most knowledgeable in household.

[a] Adolescent respondent born outside Canada, US, Germany, and Greenland.

Respondents whose opinion of their weight was just about right were more likely to consume five or more servings of fruits and vegetables a day compared to those who viewed their weight as under or over (OR 2.03, 95% CI 1.23-3.37). However, both groups of respondents in relation to their opinion of their weight were more likely to consume fruits and vegetables less than five times a day than to consume five or more times a day. Only 48% percent of respondents who reported opinion of their weight as just about right and 31% of those who reported opinion of their weight as under or over consumed fruits and vegetables five or more times a day. Respondents who reported their perceived health as very good to excellent had a greater likelihood of consuming fruits and vegetables five or more times a day compared to those who reported their health as poor, fair, or good (OR 1.57, 95% CI 1.05-2.34).

Individual Food Literacy Characteristics

When compared to respondents who report low levels of food skill, respondents were more likely to consume fruits and vegetables five or more times a day when they reported high skill levels in the ability to cook from basic ingredients (OR 1.84, 95% CI 1.12-3.02), freeze vegetables from raw (OR 1.50, 95% CI 1.00-2.24), and to adjust a recipe to make it healthier (OR 2.05, 95% CI 1.29-3.26). As previously identified, despite respondents who report higher skill levels having a higher probability of consuming fruits and vegetables five or more times a day compared to those who report low skill levels, those who report a high skill level continue to have a higher frequency of consuming fruits and vegetables less than five times a day compared to five or more times. For example, the frequency of respondents consuming fruits and vegetables less than five times a day was higher than 50% for those who reported high skill levels in the ability to cook from basic ingredients (53%) and to freeze vegetables from raw (51%). The ability to adjust a recipe to make it healthier was the only food skill variable where

respondents who reported a high skill level also reported higher frequency of consuming fruits and vegetables five or more times a day (55%). However, although a respondent's ability to adjust a recipe to make it healthier had a significant relationship to FVC (p=0.002), the ability to adjust a recipe by adding fruits and vegetables did not show a significant relationship with FVC (p=0.8).

Dietary Behaviours

Dietary behaviours, in addition to being measured by the outcome variables FVC, were also reflected in the variable where respondents were asked to rate their eating habits. Perceived eating habits remained a significant variable throughout analyses, at both the bivariate ($p<0.001$) and multivariate ($p<0.001$) levels of analyses. Respondents who reported very good to excellent eating habits had a significantly higher likelihood of consuming fruits and vegetables five or more times a day (59%), compared to those who reported poor, fair, or good eating habits (30%) (OR 3.34, 95% CI 2.25-4.95).

Societal Food Literacy Characteristics and FVC

Socio-economic measures available within the dataset that had a significant relationship to FVC included household income (p=0.02), highest level of household education attainment (p=0.02), and province of residence (p=0.001). Higher levels of household income were not associated with higher probabilities of consuming fruits and vegetables five or more times a day. Respondents from households with income between $30,000-$59,999 were less likely to consume fruits and vegetables five or more times a day compared to those who came from households with income over $90,000 (OR 0.50, 95% CI 0.30-0.82). However, compared to respondents who came from households with income over $90,000, the remaining two income brackets of less than $29,999 (OR 1.11, 95% CI 0.58-2.13) and $60,000-$89,999 (OR 0.64, 95%

CI 0.39-1.07) were not found to have significantly higher or lower odds of consuming fruits and vegetables five or more times a day.

Similar to income, higher levels of household educational attainment were not associated with higher probabilities of consuming fruits and vegetables five or more times a day. Compared to households where the highest level of educational attainment was a bachelor's degree or higher, households with lower educational attainment, apart from trades, did not show significant odds of higher or lower likelihood of consuming fruits and vegetables five or more times a day (Table 5). Households where trades education represented the highest level of household education attainment, when compared to households where the highest level of educational attainment was a bachelor's degree or higher, had lower odds of consuming fruits and vegetables five or more times a day (OR 0.34, 95% CI 0.14-0.81). Households where trades education represented the highest household education attainment, also had the lowest frequency (23%) of consuming fruits and vegetables five or more times a day compared to all other levels of household education.

More respondents from Quebec (60%) and New Brunswick (54%) consumed fruits and vegetables five or more times a day as compared to those who consumed fruits and vegetables less than five times a day. Compared to respondents from the province of British Columbia, respondents from Quebec (OR 2.67, 95% CI 1.32-5.43) had higher odds of consuming fruits and vegetables five or more times a day, and respondents from Manitoba lower odds (OR 0.35, 95% CI 0.13-0.95).

Predictive Model Results

The results from the final logistic regression model are displayed in Table 6. The final regression model was bootstrapped and replicated 500 of the desired 500 replications, had a

significant p value of less than 0.001, and a goodness of fit of Prob>chi= 0.19, indicating a good fit. Logistic regression analyses found sex to have a significant relationship with FVC (p=0.04), with male respondents significantly more likely to consume fruits and vegetables five or more times a day compared to females (OR 1.73. 95% CI 1.03-2.88). Additionally, respondents who reported very good to excellent eating habits had a significantly higher probability of consuming fruits and vegetables five or more times a day compared to those who report poor, fair, or good eating habits (OR 2.91, 95% CI 1.84-4.62). Furthermore, those from households where the highest level of household educational attainment was trades were less likely to consuming fruits and vegetables five or more times a day than those from households where the highest level of household educational attainment was a bachelors' degree or higher, (OR 0.36, 95% CI 0.15-0.87). An analysis conducted to compare differences between the respondents that were included (n=674) and excluded for missing data (n=116) for the final logistic regression model found no significant difference between the group's likelihood of consuming fruits and vegetables five or more times a day (p=0.1).

Table 6

Logistic Regression Model Predicting Probability of Consuming Fruits and Vegetables Five or More Times a Day for Canadians, 12 to 17 Years of Age, Canadian Community Health Survey – Rapid Response on Food Skills (Part 2) – Mechanical Skills and Food Conceptualization 2013 (n=674).

Variable	SD (z)	(SE)	Adjusted odds ratio (95% CI)		*P*-value
Sex (Ref = female)					
Male	2.08	-0.45	1.73	[1.03,2.88]	0.04
Opinion of weight (Ref = under or over)					
Very good to excellent	1.57	-0.44	1.55	[0.90,2.70]	0.1
Eating habits (Ref = poor, fair, or good)					
Very good to excellent	4.54	-0.69	2.91	[1.84, 4.62]	<0.001
Cooking from basic ingredients (Ref = low)					
High	0.71	-0.42	1.27	[0.66, 2.44]	0.5
Freezing raw vegetables (Ref= low)					
High	1.53	-0.37	1.47	[0.90, 2.40]	0.1
Adjust a recipe to make it healthier (Ref = low)					
High	1.78	-0.52	1.71	[0.95, 3.10]	0.1
Highest level of household education attainment (Ref = bachelor's degree or higher)					
Below High School	1.35	-1.61	2.44	[0.67, 8.87]	0.2
High School	-1.14	-0.25	0.64	[0.30,1.38]	0.3
Some Post Secondary Education	0.72	-1.38	1.76	[0.38, 8.16]	0.5
Trades	-2.27	-0.16	0.36	[0.15,0.87]	0.02
Certificate or Diploma	-0.32	-0.26	0.91	[0.53,1.59]	0.8

Note: goodness of fit of Prob>chi= 0.19.

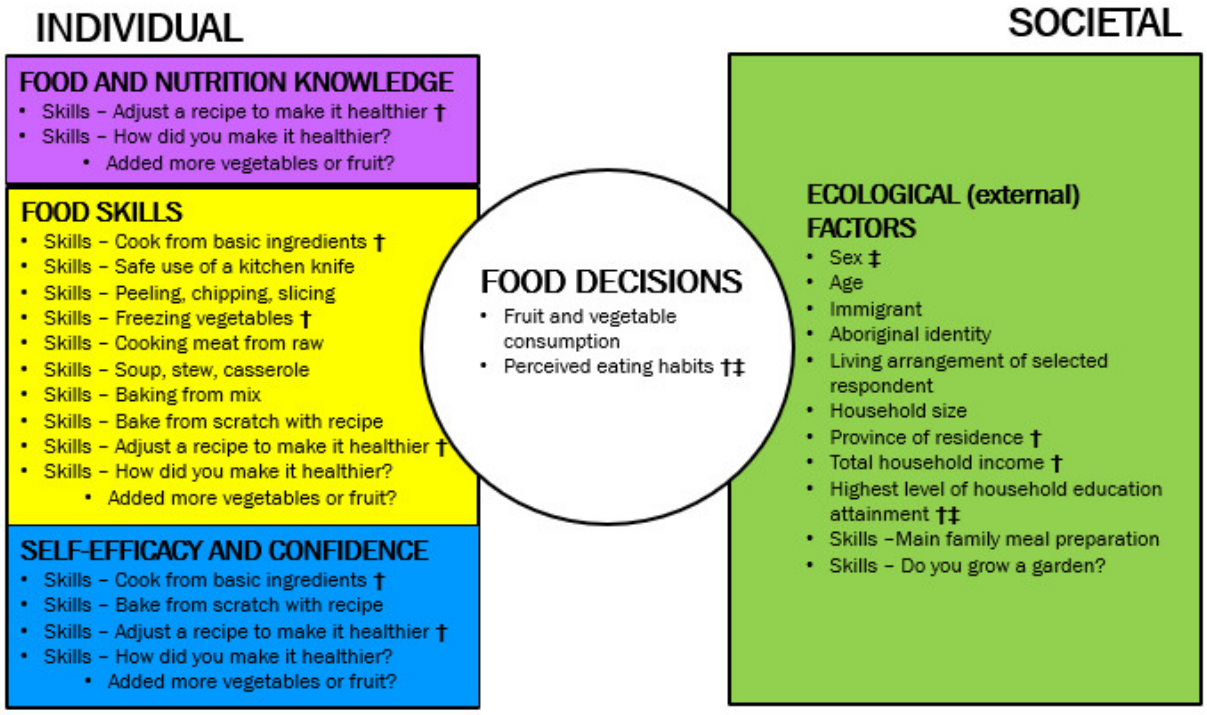
Chapter 5 - Discussion

Study results found a positive relationship between several attributes of food literacy and FVC among Canadian adolescents. While basic or simple food skills alone were not found to have a relationship, complex and multifaceted food skills were found to positively influence adolescent FVC. The relationships found between multifaceted food skills and adolescent FVC suggest that food literacy attributes are interconnected and have reciprocal relationships. Societal factors and an adolescent's perception of their eating habits had a significant relationship to their likelihood of consuming fruits and vegetables five or more times a day and were found to have a relationship with adolescent FVC at both the bivariate and multivariate levels of analyses. Although high skill levels in multifaceted food skills were found to have positive relationships to adolescent FVC at the bivariate level of analysis, when the highest level of household educational attainment, sex, and perceived eating habits were controlled for, these food skill variables were not found to have a significant relationship with adolescent FVC, suggesting that societal factors potentially influence individual food literacy characteristics.

The food literacy framework developed by Thomas et al. (2019) used to guide the following discussion, groups food literacy categories under three headings: individual characteristics, dietary decisions, and societal/ external factors. Figure 8 displays the variables that were found to have a significant relationship with adolescent FVC, and the corresponding food literacy category. It should be noted, however, that the food literacy categories and attributes operate in an interdependent manner (Azevedo Perry et al., 2017; Thomas et al., 2019), and as such it is difficult to discuss each category in isolation.

Figure 8

Food Literacy Variables Found to be Predictive of Adolescent Consumption of Fruits and Vegetables Five or More Times a Day, for the Sample Population, Canadians, 12 to 17 Years of Age, Canadian Community Health Survey – Rapid Response on Food Skills (Part 2) – Mechanical Skills and Food Conceptualization 2013 (N=790).



Note. Food literacy table adapted from "Complexities in conceptualizing and measuring food literacy" by H. Thomas et al., 2019, *Journal of the Academy of Nutrition and Dietetics, 119*(4), 563-573. † = Variables found in the bivariate analyses to have a significant relationship with adolescent fruit and vegetable consumption. ‡ = Variables found to have relationships with adolescent fruit and vegetable consumption at the multivariate level of analyses.

Individual Food Literacy Characteristics and FVC

Individual food literacy attributes that were found to have a relationship with Canadian adolescent FVC were multifaceted, comprising of several food literacy attributes. These multifaceted food skills were complex in nature, requiring the ability to perform several food skills to complete, however the basic food skills that are the building blocks of these more

complex skills were not found to have a relationship with adolescent FVC. Adolescents who reported high skill levels in three multifaceted food skills - the ability to cook from basic ingredients, freeze vegetables from raw, and to adjust a recipe to make it healthier - were found to have a higher probability of consuming fruits and vegetables five or more times a day compared to those who reported low skill levels.

Food Skills

Adolescents who report high confidence in their ability to freeze vegetables from raw, cook from basic ingredients, and adapt a recipe to make it healthier require the ability to perform multiple basic mechanical food skills, such as chopping, measuring, cooking, and reading recipes, and as such are multifaceted involving many factors to complete. The positive relationships found in this study between multifaceted food skills and adolescent FVC is consistent with previous studies that have concluded that food skills include more than simple technical skills such as chopping (Azevedo Perry et al., 2017), and that programs which teach multifaceted food skills, such as the ability to cook from basic ingredients, have been found to be positively associated with FVC (Bailey et al., 2019; Brooks & Begley, 2014). Interestingly, at the bivariate level of analyses, the ability to perform basic skills such as the safe use of a kitchen knife, and peeling, chopping, and slicing, were not found to have a significant relationship with adolescent FVC, suggesting that food skills that have relationships with FVC involve more than the performance of a mechanical skill. This study's findings add to the growing body of research surrounding the relationship between food skills and dietary behaviours, suggesting that the level of food skill development, and or the complexity of the food skill, may have differing impacts on the relationship between a food skill and dietary behaviour.

Food and Nutritional Knowledge

Food skills that were multifaceted in nature were found to have a significant relationship with adolescent FVC, further highlighting how these multifaceted food skills are reflective of other food literacy attributes, such as food and nutritional knowledge. For example, to adjust a recipe to make it healthier, an adolescent must have the food and nutritional knowledge to know what constitutes a healthy meal, and that health choices have a positive influence on their present and future well being. The positive relationship found between adolescent FVC and those who report high skill levels in the ability to adjust a recipe to make it healthier is consistent with relationships between food and nutritional knowledge and FVC found within the literature, where increased food and nutritional knowledge was associated with higher FVC (Bailey et al., 2019; Fleary et al., 2018; Lake et al., 2004; Souza Santos et al., 2019). Furthermore, food and nutritional knowledge create the conditions for change (Vaitkeviciute et al., 2014), and as such may contribute to an adolescent's decision to learn how to adjust a recipe to make it healthier.

Self-Efficacy and Confident

The ability to adjust a recipe to make it healthier or cook from basic ingredients are potentially reflective of higher levels self-efficacy and confidence. The desire to learn how to prepare food and adjust a recipe to make it healthier is representative of the attribute of food attitude, captured under the food literacy category of self-efficacy and confidence (Thomas et al., 2019). The attributes of food and nutritional self-efficacy and cooking self-efficacy are also reflected in the ability to adjust a recipe to make it healthier, as an adolescent who reports high confidence in this food skill likely believes in their ability to apply food and nutritional knowledge to prepare healthy meals. The positive relationships found between food skills that potentially require higher levels of self-efficacy and adolescent FVC are consistent with other

studies which have found programs that incorporated food skills within their interventions were positively associated with cooking self-efficacy (Bailey et al., 2019; Vaitkeviciute et al., 2014), and higher self-efficacy scores were associated with healthier food choices (Gracey et al., 1996). The reciprocal relationship between the food literacy attributes further emphasises the multifaceted nature of the food skills that have a significant relationship with adolescent FVC.

Dietary Behaviours and FVC

The significant relationship between an adolescents' perceived eating habits and FVC at both the bivariate and multivariate analyses is suggestive of a high health value placed on FVC. The current study found that adolescents who viewed their eating habits as very good or excellent had a higher likelihood of consuming fruits and vegetables five or more times a day. This finding could be supportive of the idea that a healthy attitude towards diet may result in higher FVC and may be reflective of healthy diet choices. These findings support previous study findings that have reported that adolescents perceive FVC as a component of a healthy diet (Bailey et al., 2019; Sahingoz & Sanlier, 2011). A study by Ronto et al. (2016) found adolescents to believe that having a healthy attitude or placing a high value towards healthy eating would result in a healthy diet and lifestyle. Additionally, a study by Gracey et al. (1996) found adolescents who had a healthy attitude towards diet, where they tried to eat healthy or considered their food choices to be healthy, had a higher self-efficacy score, and that higher self-efficacy scores were associated with healthier food choices. These studies are consistent with this study's findings and may support a link between value and attitude placed on diet and dietary behaviour.

Societal/ External Factors and FVC

Total household income, the highest level of household educational attainment, geography, sex, and an adolescent's opinion of their weight were all found within the current

study to have significant relationships to an adolescent's likelihood of consuming fruits and vegetables five or more times a day. However, the relationships found between the societal/ external factors and adolescent FVC within this study differed from those identified within the literature.

Household Income

This study found that adolescent FVC was not associated with increasing total household income. Fruit and vegetable consumption was found to be lowest among those from households in the lower middle-income bracket of $30,000-$59,999. Adolescents who came from households in the highest income bracket of greater than $90,000 were more likely to consume fruits and vegetables five or more times per day, compared to those who came from households that fell in the income bracket of $30,000- $59,999. However, the odds of adolescents from households with total income below $29,999, or those between $60,000-$89,999, were not found to be significantly different from those with total household incomes over $90,000. The results associated with income are contradictory to those found within the literature review, where increasing household income was often associated with healthier dietary behaviours, including increased FVC (Fleary et al., 2018; Ghasab et al., 2017). The inconsistency found between adolescent FVC, and total household income suggests that increasing household income is not always associated with healthier dietary behaviours, such as higher FVC, nor is income the most reliable measure of societal factors affecting dietary behaviours.

Household Education

Within the literature, the highest level of household educational attainment has increasingly been used as a measure of SES instead of household income (Bau et al., 2011; Ghasab et al., 2017; Pearson et al., 2009; Pitel et al., 2018; Sahingoz & Sanlier, 2011; Sichert-

Hellert et al., 2011), hence at the multivariate level of analyses this study used the variable highest level of household educational attainment as a measurement of SES. Although the highest level of household education attainment was found to have a significant relationship to the likelihood of Canadian adolescents consuming fruits and vegetables five or more times a day, the study results were mixed. The final logistic regression model found that adolescents from households with higher levels of household education attainment (bachelors or higher) were significantly more likely to consume fruits and vegetables five or more times a day, when compared to households where the highest level of household educational attainment was trades. Additionally, bivariate analyses found that adolescents from households where the highest level of educational attainment was below high school, some post secondary education, less than a bachelor's degree, or bachelor's degree or higher, had a higher frequency of consuming fruits and vegetables five or more times a day, compared to those who came from household with high school education or trades education. These results differ from those found in the literature, where increasing levels of household educational attainment have been associated with increased levels of FVC and healthier dietary behaviours (Bau et al., 2011; Chartatos et al., 2018; Fleary et al., 2018; Garrido-Fernández et al., 2019; Ghasab et al., 2017; Nagy-Pénzes et al., 2020; Pearson at al., 2009; Pitel et al., 2013; Sahingoz & Sanlier, 2011). The findings in this study suggest that not all levels of post secondary education are associated with higher adolescent FVC.

Geography

Geography presents as an underexplored societal/ external factor that warrants further investigation in relation to its potential impact on the relationship between household education and FVC. Adolescents from the province of Quebec had higher odds of consuming fruits and vegetables five or more times a day, and those from the province of Manitoba had lower odds

compared to adolescents from the province of British Columbia. The variations within provincial social and health policy fall outside the scope of this study, however there are potential relationships between geography, household education, and FVC that present an opportunity for future study. For example, in 2011 “census metropolitan areas (CMA) had higher proportions of people with university degrees (30.9%) and lower proportions of people with a trades certificate (10.1%), compared with the national averages for university degrees (25.9%) and trades certificates (12.1%)” (Ministry of Industry, 2013, p.17), suggesting the reverse in more rural areas. Studies have suggested that access to nutritious food is poorer in rural areas, however few studies regarding food access and environment have been conducted in Canada outside of the CMA (Health Canada, 2013), therefore, regions outside of the CMA potentially have more families who have the highest level of household educational attainment of trades, and/ or may have different challenges in accessing healthy foods compared to those who reside in CMA, as such these populations may require different health initiatives. It is not possible to make these associations within the available data set analyzed, as the geographical data available does not account for rural/ urban variations, nor identifies geography beyond provincial residency.

Sex

Contrary to findings within the literature where female adolescents were found to have a greater likelihood of higher FVC compared to males (Bailey et al., 2019; Ghasab et al., 2013; Park et al., 2013; Pearson et al. 2009; Sahingoz & Sanlier, 2011), this study found that when controlling for highest level of household education, the ability to cook from basic ingredients, freeze vegetables from raw, adjust a recipe to make it healthier, and adolescents’ perceived eating habits, males were found to have a higher likelihood of consuming fruits and vegetables five or more times a day compared to females. These results are also different from other studies

where highest level of household educational attainment was utilized as a measure of SES that found higher SES to be associated with healthier dietary behaviour in female adolescents (Pitel et al., 2013; Sahingoz & Sanlier, 2011; Sichert-Hellert et al., 2011), since this study found that males from households where the highest level of educational attainment was a bachelor's degree or higher were more likely to consume fruits and vegetables five or more times a day than females. The literature reviewed within this study where relationships between adolescent sex and FVC were discussed originated from countries other than Canada. The current results suggest that the relationship between sex and adolescent FVC may differ in Canada from other countries.

Opinion of Weight

This study's findings suggest that the adolescent's opinion of their weight may be a more accurate measurement than BMI when investigating relationships between weight and dietary behaviour. The study found that adolescents whose opinion of their weight was just about right had a higher likelihood of consuming fruits and vegetables five or more times a day, compared to those whose opinion of their weight was either under or over, however no significant relationship was found between BMI and FVC. These results add to the discussion regarding the appropriateness of using BMI as a measurement of healthy weight or overall health status, in addition to the use of BMI as a measurement of the relationship between weight status and dietary behaviour. Although the majority of studies use BMI as a measurement of weight status, the appropriateness of using BMI as an outcome variable to measure healthy weight has been criticized for its lack of ability to distinguish fat from muscle and the location of body fat (Bell et al., 2018; Gutin, 2019). The significant relationship between a respondent's opinion of their weight and FVC supports initiatives that propose new measurements of health in relation to

weight, such as the Health at Every Size (HAES) approach. The HAES approach encourages healthy lifestyle through intuitive eating, body acceptance, and physical activity for movement and health, instead of focusing on body weight, shape, or size (Penney & Kirk, 2015). However, philosophies such as the HAES are relatively new (Penney & Kirk, 2015), as such further research is needed to better understand the relationship between weight and dietary behaviour. The use of variables such as opinion of weight, verses BMI, when investigating dietary behaviour, such as FVC, offer an area for further study.

Chapter 6 – Summary

This study aimed to answer the research question, what is the relationship between food literacy and FVC among Canadian adolescents. The study found several key findings, and a number of recommendations for clinical practice and future research initiatives. The following chapter contains a discussion on the strengths and limitations of the study, implications for practice and research, and a summary of key findings.

Strengths and Limitations

Study Strengths

This study draws from a large data set to help fill a gap within the growing literature on food literacy. Presently, national survey data regarding adolescent food literacy is limited, and within the literature reviewed, there was a notable gap related to studies that examined adolescent food literacy within the Canadian population. There were also no studies identified within the literature review that analysed the current data set. The CCHS collects data from a large population across a vast geographical area to produce large samples that aid in the ability to generalize study results to the larger population of Canadian adolescents.

Study Limitations

Despite the strengths of this study's findings, it has a number of limitations, including the cross-sectional design, time lapse between data collection and analyses, potential selection bias, generalizability, gaps within the data collection, and limitations within the current study scope.

As a cross-sectional study, the associations between the selected food literacy variables and FVC were assessed at the same point in time and are therefore limited in their ability to identify causality or draw conclusions between food literacy attributes and FVC (Polit & Beck, 2017). However, the cross-sectional study results can serve to inform hypothesis generation for

future studies (Polit & Beck, 2017), supporting more rigorous investigation of the relationship between food literacy and dietary behaviour.

The study results represent the population estimates from 2013, and as such may not be generalizable in 2021. However, the Canadian adolescent population has experienced lower growth than the overall population and as such data collected in 2013 can be argued to remain relevant in 2021. Since 2013 the Canadian population has increased by 7.9% (Macrotrends, 2021). Between 2013 and 2020 youth aged 10 to 14 years increased from 1,886,668 to 2,072,100, and those aged 15 to 19 years dropped from 2,154,873 to 2,100,865 (Statistics Canada, 2020b). The combined growth represented by Canadian youth increased by 7.3% between 2013 and 2020, representing a lower increase as compared to the overall population. Furthermore, those aged 0-14 years of age represent 15.9% of the population in 2020, and this representation is estimated to remain consistent, at between 15% and 16% by 2025 (Statistics Canada, 2020a). Therefore, despite the time lapse between the collection of the data and the analyses, the lower rate of population growth represented by youth can be argued to minimize some of the population change estimated between 2013 and 2021. Furthermore, despite the age of the data, there remains a lack of data collection representative of food literacy within the focus population, and as such the study results remain useful in guiding future research and programing initiatives.

Despite the efforts of Statistics Canada to weight responses, and the analyses being conducted on bootstrapped samples, there remains an unavoidable potential for self-selection bias. Person-level weighting for the rapid response sample were calibrated by province, by age group, and by sex to ensure weights sum up to known population totals (Statistics Canada, 2013b). However, it is difficult to ascertain if the sample's highest level of household

educational attainment is aligned with national averages. National data related to the overall Canadian population reports lower household educational attainment than this study's sample at the time of the data collection. According to the National Housing Survey in 2011, highest level of household education attainment reported as secondary school was 25.6%, compared to 16.8% of the study's population, and a bachelor's degree or higher was 13.4% compared to 37.2% of the study population (Statistics Canada, 2011a). These variances identified may be related to the limited study population of households where children 12-17 years reside and may represent a population with higher education. However, this discrepancy may result in an underrepresentation of adolescents from households where the highest level of educational attainment is below a bachelor's degree and therefore further study should look at adolescents from lower educated households to see if this is in fact the case.

It should be noted that the Aboriginal population referred to within the study results are only reflective of the survey respondent's who self identify as Aboriginal and are not representative of the overall Canadian Aboriginal population. Furthermore, generalizability of the results to the respondent's who identify as Aboriginal is limited as the CCHS FS2 excludes Canadians living on Aboriginal reserves and settlements, living in two remote health regions of Québec (Région du Nunavik and Région des Terres-Criesde-la-Baie-James), living in all three Territories, institutionalized persons, and those who are full-time members of the Canadian Forces (Statistics Canada, 2013b). As such, the study results can not be generalized to these populations. Although no significant relationships were found between respondent's who identify as Aboriginal and FVC, when interpreting results attributed to the respondent's who identify as Aboriginal, these results are only applicable to Aboriginal persons not living on reserves or Aboriginal settlements and therefore may not be reflective of all Aboriginal persons.

Due to the sparseness of the data for some of the provincial samples, generalizability of study results beyond the national level is also limited. Geographical factors, such as rural verses urban, are also not evaluated within this study, limiting the ability of this study to ascertain additional societal /external factors affecting FVC of Canadian adolescents. To better understand factors affecting FVC within the Canadian context, future studies are needed to explore the impact of geographical factors on dietary behaviours.

The ability of this study to make associations between food and nutritional knowledge and FVC is limited to the data collected by the CCHS RFS2 survey. Respondents within the survey were asked questions regarding eating habits, basic ingredients within meals, and number of servings of fruits and vegetables, however there was no collection of food diaries to allow for the quality of the reported ingredients and foods to be evaluated. Furthermore, the outcome variable, FVCGTOT, does not differentiate between consumption of potatoes, which are processed as a carbohydrate, and fruit juices, which potentially contain a higher sugar content and lower fiber content than whole fruit. Although, there are variables available within the data set that differentiate between types of fruits and vegetables consumed, the analyses of these data were outside the scope of this study, and further studies are needed to analyze the quality of adolescent FVC.

The CCHS used within this study collected the variable ‘sex’ as only ‘male’ or ‘female’, and did not present other categories identifying sexual orientation, assigned sex at birth, or gender identity (Statistics Canada, 2013c). Although the CCHS in 2019 created a category of questions related to sex and gender, in which respondents were asked ‘what was your sex at birth?’ and ‘what is your gender?’, this category is not available within the data set used within this study (Statistics Canada, 2019). The current study uses the term sex to refer to male and

female as identified within the data set, however it should be acknowledged that the term 'sex' remains ambiguous in definition.

Finally, this study found the adolescent respondent's opinion of their weight vs BMI had a significant relationship to FVC. Considering the controversy surrounding the appropriateness of using the BMI as a measure of healthy weight, future studies should consider evaluating alternative measurements of health as related to weight, including the use of a respondent's opinion of their weight.

Implications for Clinical Practice and Research

The identified limitations and gaps, despite restricting this studies' ability to provide a more comprehensive understanding of the relationship between adolescent food literacy and dietary behaviours, serve to inform the development of programs that aim to improve food literacy and or, dietary behaviours among adolescents. The study results also aid in the development of future study and survey designs to measure the levels of food literacy more accurately within the Canadian adolescent population, allowing for continued investigation into the impact that food literacy has on dietary behaviour. As an emerging and rapidly expanding construct, conceptualizations of food literacy have become more delineated since the data from the CCHS FS2 was collected in 2013, hence there are a number of recommendations for future survey and study designs to facilitate further research initiatives surrounding food literacy and Canadian adolescents.

Food Skills

Study results found food skills that were multifaceted and reflective of several food literacy attributes to have a positive relationship to adolescent FVC. These results suggest that food literacy programs should aim to teach and evaluate food literacy attributes that build the

more complex skills needed to be able to adjust a recipe, or to cook from basic ingredients, including attributes of food and nutritional knowledge and self-efficacy.

Household Education and Income

The present study found that total household income and highest level of household educational attainment did not follow patterns previously identified within the literature, where increasing income or education were found to be positively associated with higher FVC (Bau et al., 2011; Chartatos et al., 2018; Fleary et al., 2018; Garrido-Fernández et al., 2019; Ghasab et al., 2017; Nagy-Pénzes et al., 2020; Pearson at al., 2009; Pitel et al., 2013; Sahingoz & Sanlier, 2011). Therefore, future food literacy programs should aim to reach populations of all incomes and household education levels.

Further research is needed to better understand the relationship between various types of household educational attainment and FVC, including what barriers these populations may encounter and how to best support adolescents from these households to engage in healthy eating behaviours. To better understand the impact of total household income and the highest level of household education within the Canadian context, geographical factors warrant further exploration, including rurality vs CMA's.

The expansion of the data set to include the highest level of educational attainment for each adult caregiver within the home would aid in evaluating the impact of highest level of household educational attainment by sex. Since the highest level of household education is increasingly being used as a measure of SES within the literature, this variable should be considered for weighting within the CCHS design.

Food Literacy Framework

Future study and survey designs should aim to incorporate available food literacy frameworks to guide study investigation and survey design. The food literacy framework by Thomas et al. (2019) offers a format from which to base future food literacy questionnaires, ensuring that data is collected for attributes from each food literacy category, allowing for a more comprehensive evaluation of the relationships between food literacy and dietary behaviour. The working group that is responsible for the development of the above mentioned framework discussed in their paper the potential development of a tool suitable for food literacy program evaluation that may also be utilized in future data collection efforts (Thomas et al., 2019). Considering the variables found to have significant relationships with FVC within this study involved capacity in a number of food literacy categories, future survey designs aimed at understanding the influencing factors to adolescent diet behaviours should aim to incorporate questions that evaluate all categories and attributes within the Thomas et al. (2019) framework.

Data Collection of Processed/ Snack Foods

Data collected on adolescent dietary behaviours should be expanded to include the consumption of savory, sweet, and processed foods to better understand the eating habits of adolescents. A number of studies have found positive correlations between food literacy characteristics, such as food and nutritional knowledge (Bailey et al., 2019; Fleary et al., 2018; Lake et al., 2004; Vaitkeviciute et al., 2014; Souza Santos et al., 2019) and societal/ external factors (Bau et al., 2011; Fleary et al., 2018; Ghasab et al., 2017; Gracey et al., 1996; Nagy-Pénzes et al., 2020; Park et al., 2013; Pearson et al., 2009; Pitel et al., 2013; Videon & Manning, 2003), to the lower consumption of savory, sweet, and processed foods in addition to higher FVC. Considering the consumption of highly processed foods has been linked to increased

obesity rates that potentially lead to lower health outcomes (Crino et al., 2015; Djupegot et al., 2017; Holman & White, 2011; Lam & Adams, 2017; Nagle et al., 2015; IDRC, 2011, Poirier et al., 2019; Whiteman & Wilson, 2016; WHO, 2002), these foods warrant inclusion in future survey designs.

Availability of FVC

A significant barrier to healthy eating, identified by adolescents within the literature, was the availability of fruits and vegetables within the home environment (Brooks & Begley, 2014; Ghasab et al., 2017; Gracey et al., 1996), as such future surveys should consider adding questions related to the availability of fruits and vegetables.

Parental Food Literacy

Additionally, both the primary caregiver within the household responsible for meal preparation, as well as the adolescent should be interviewed. Parents have a significant influence over the early food environment (Ghasab et al., 2017; Hanson et al., 2004; Mokhtari et al., 2017; Orehek & Ferrer, 2018), therefore understanding how their food literacy impacts the home food environment may aid in understanding the relationships between parental food literacy and adolescent food literacy, and as such potentially inform future food literacy program development. Within the current data set, one individual from each residence is selected to respond, therefore associations between parental food literacy and the dietary behaviours of adolescents are limited.

Summary and Conclusions

A general ‘de skilling’ among adolescents with respect to food choices and the preparation of and consumption of foods associated with a healthy diet (Caraher &Lang, 1999, p. 9; Jaffe & Gartler, 2006; Slater & Mudryj, 2017) has been attributed to changing food practices

within the home associated with a nutritional transition to a low-quality ultra-processed diet, which require little food preparation skills (Monteiro et al., 2016; Slater & Mudryj, 2017). It has been theorized that this shift has reduced the consumption of minimally processed foods such as fruits and vegetables (Monteiro et al., 2016; Nelson et al., 2013; Slater & Mudryj, 2017). In combination, the loss of food skills and knowledge, low quality food choices, and poor dietary behaviours, put youth at risk of future chronic disease attributed to poor diet quality (Crino et al., 2015; Djupegot et al., 2017; Holman & White, 2011; IDRC, 2011; Lam & Adams, 2017; Nagle et al., 2015; Poirier et al., 2019; Whiteman & Wilson, 2016; WHO, 2002). Developing food knowledge, skills and food related self-efficacy in adolescence may help better support these individuals to make healthier informed food choices, limit their consumption of ultra-processed foods, and thereby improve their health.

Food skills and food knowledge are core attributes of food literacy (Thomas et al., 2019), which has been found to help shape adolescent eating behaviours (Vaitkevicicute et al., 2014). Food literacy represents the interdependent concepts related to the facets influencing dietary practices and as such has emerged as a concept to describe the "everyday practicalities associated with healthy eating (Vidgen & Gallegos, 2014, p.50), and has garnered substantial attention within the literature and in program development aimed at understanding factors affecting diet decisions and at improving dietary behaviours (Truman et al., 2017).

This study's aim was to examine the relationship between food literacy and FVC among Canadian adolescents, through a secondary analysis of the Canadian community health survey, rapid response on food skills (Part 2) – mechanical skills and food conceptualization. Significant relationships between FVC and food literacy were evident in food skills that were multifaceted, requiring that adolescents have the ability to perform a number of basic food skills and reflective

of several food literacy attributes. Performance of the multifaceted food skills reflects a level of food and nutritional knowledge and cooking self-efficacy, further emphasizing the interconnected and reciprocal nature of food literacy described by Thomas et al. (2019). These results suggest that food literacy programs should aim to teach and evaluate food literacy attributes that build the more complex skills needed to be able to adjust a recipe, or to cook from basic ingredients, including attributes of food and nutritional knowledge and self-efficacy.

Total household income, the highest level of household educational attainment, geography, sex, and an adolescent's opinion of their weight were all found within the current study to have significant relationships to an adolescent's likelihood of consuming fruits and vegetables five or more times a day. However, some of the relationships found between the societal/ external factors and adolescent FVC within this study were inconsistent with those identified in previous studies, were increasing levels of household income (Fleary et al., 2018; Ghasab et al., 2017) and household educational attainment were associated with healthier dietary behaviours, including increased FVC (Bau et al., 2011; Chartatos et al., 2018; Fleary et al., 2018; Garrido-Fernández et al., 2019; Ghasab et al., 2017; Nagy-Pénzes et al., 2020; Pearson at al., 2009; Pitel et al., 2013; Sahingoz & Sanlier, 2011). This study found that adolescent FVC was not associated with increasing levels of total household income or highest level of educational attainment, instead the highest household income and educational categories were only found to be predictive of higher adolescent FVC when compared to the lower middle income category of $29,999-$60,000 and the highest level of household educational category of trades. The study's analyses of the relationship between household educational attainment and adolescent FVC suggest that not all levels of post secondary education are associated with higher adolescent

FVC. Study results pertaining to household education and income suggest future food literacy programs should be inclusive of adolescents from any SES.

Other interesting study findings pertain to sex and opinion of weight. This study found male adolescents to be more likely to consume fruits and vegetables five or more times a day compared to females in the logistic regression analyses, contrary to previous findings were females had higher FVC (Bailey et al., 2019; Ghasab et al., 2013; Park et al., 2013; Pearson et al., 2009; Ronto et al., 2016; Sahingoz & Sanlier, 2011). Also, while an adolescent's opinion of their weight was associated with FVC, BMI was not, these findings add to the discourse within the literature regarding the lack of validity in using BMI as a measure of healthy dietary behaviour.

Key study findings suggest that higher levels of adolescent food literacy, as reflected in multifaceted food skills that are reflective of individual capacity in several food literacy categories, has the potential to positively impact their FVC. However, when societal/ external factors are controlled for, food skills were not found to have a significant relationship with adolescent FVC, suggesting that factors outside of the control of the individual have the potential to minimize the influence of individual food literacy characteristics on adolescent FVC.

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Appendix B - Narrative Description of Literature Search

Data Base searched	CINAHL Ebsco	Science Direct	PubMed Medline
Narrative of search: Conducted - May 2018, Updated - November 2020	S4 - "food literacy" (MH "Food Preferences") OR (MH "Portion Size") OR (MH "Food Habits") OR (MH "Eating Behavior") AND adolescent AND home environment AND skill AND knowledge S3 - "nutritional knowledge AND adolescents" S2 - "nutritional behavior AND adolescents" S1 - "food literacy AND (adolescents or teenagers or teens or young people)"	"nutritional behavior" OR "food habits" AND adolescent AND "home environment" AND skill AND "Nutritional knowledge "OR "food literacy"	(((((('nutritional AND knowledge') OR ('food AND skills')) OR ('food AND literacy')) OR (diet OR food AND 'self AND efficacy')) OR ('dietary AND behaviour' OR 'food AND decisions' Or 'food AND choice'))
Limiters or Filters	Subject Age - adolescent: 13-18 years Source – Academic Journal Language - English	Medicine and Dental; Nursing and health professionals	English adolescent: 13-18 years Humans

Appendix C - Literature Search Inclusion and Exclusion Criteria

Inclusion	Exclusion
➢ Scholarly/ peer reviewed/ English ➢ Articles that included participants between 12 and 17 years of age ➢ Articles that included a discussion of food literacy or food literacy attributes	➢ Studies that did not include data collected from adolescents ➢ Articles that focus on specific population including any of the following: o Athletes o Pre and peri natal populations o Populations where ecological factors have greater influence than food literacy as a concept, such as severe food insecurity, rural or tribal Indian, Ethiopia, homelessness, or refugees o Populations affected a chronic health conditions, nutritional disorder or syndrome, or other disease or chronic condition, including ethanol, diabetes, malnourishment, or cancer ➢ Articles that focused on oral health ➢ Articles that focused on supplements ➢ Articles that focused on weight loss interventions ➢ Articles that focused on micronutrient

Appendix D - Variables Table

Canadian Community Health Survey– Rapid Response on Food Skills (Part 2) – Mechanical Skills and Food Conceptualization, 2013				
Concept:	**Related variables of interest**	**Type of variable**	**Range**	**Description of the variable Values - Categories**
Fruit and vegetable consumption (How many servings of other vegetables do you usually eat?)	FVCGTOT	Categorical; Ordinal Dependent variable	1-3	1- Eats fruits and vegetables less than 5 times per day 2- Eats fruits and vegetables less than 5 times per day 3- Eats fruits and vegetables more than 10 times per day 9 - Not stated
Fruit and vegetable consumption - recategorized (How many servings of other vegetables do you usually eat?)	FVC	Categorical – recoded *	0-1	0 - Eats fruits and vegetables less than 5 times per day 1 -Eats fruits and vegetables 5 times per day or more
Daily consumption – total fruits and vegetables (Based on FVCDJUI, FVCDFRU, FVCDSAL, FVCDPOT, FVCDCAR, FVCDVEG. The CCHS measures the number of times (frequency), not the amount consumed)	FVCDTOT	Continuous; ratio	0.0- 999.9	0.0-24.2 – Times per day 999.9 – Not stated
Age (“What is your age?)	DHH_AGE	Continuous	Years 12-105	Continuous ratio: Years between 12-17 Data set will be drawn only for respondents aged 12-17 years of age.
Sex	DHH_SEX	Categorical; nominal	1-2	Male – 1 Female - 2
Household size Number of persons	DHHDHSZ	Continuous	0-12	0-12
Living arrangement of selected respondent	DHHDLVG	Categorical	1-99	1- Unattached individual living alone 2- Unattached individual living with others

Canadian Community Health Survey– Rapid Response on Food Skills (Part 2) – Mechanical Skills and Food Conceptualization, 2013				
Concept:	**Related variables of interest**	**Type of variable**	**Range**	**Description of the variable Values - Categories**
				3- Living with spouse/ partner 4- Parent living with spouse/ partner and children 5- Single parent living with children 6- Child living with a single parent 7 – Child living with single parent, siblings 8 - Child living with two parents 9 - Child living with two parents, siblings 10 - Other 99 - not stated
Living arrangement of selected respondent – recategorized	lvg	Categorical -recoded *	1-3	1 - child not living with parent 2 - child living with single parent 3 - child living with 2 parents
Aboriginal Identity	SDCDABT	Categorical	1-9	1 – Aboriginal (First nations, Metis, Inuit) 2 – Not Aboriginal 6 – Not applicable 9 – Not stated
Immigrant	SDCFIMM	Categorical	1-9	1 – Yes 2 – No 9 – Not stated
Self-perceived health (In general, would you say your health is...)	Gen_01	Categorical		1 - Excellent 2 - very good 3 - Good 4 - Fair 5 - Poor 7 – Don't Know
Self-Perceived health		Categorical – recoded *	1-2	1 – Very good or excellent 2 – Good, fair, or poor

Canadian Community Health Survey– Rapid Response on Food Skills (Part 2) – Mechanical Skills and Food Conceptualization, 2013				
Concept:	**Related variables of interest**	**Type of variable**	**Range**	**Description of the variable Values - Categories**
				Missing – (7)
Respondent's opinion of own weight - self-reported (Do you consider yourself?)	HWT_4	Categorical	1-9	1-Overweight 1-Underweight 3- Just about right 6- Not applicable 7- Don't Know 8- Refusal 9- Not stated
Respondent's opinion of own weight - self-reported	weightop	Categorical – recoded *	1-2	1 – Just about right 2 – under or over Missing – Don't know, refused, or not stated
BMI class. (12 to 17)	HWTDCOL	Categorical	1-9	1-Neither overweight nor obese 2-Overweight 3-Obese 6- Not applicable 9- Not stated
BMI	BMI	Categorical – recoded *	1-2	1 - Neither overweight nor obese 2 - Overweight or obese Missing – (6-9)
Food skills	**FS2_****			
Eating habits In general, would you say that your eating habits are:	FS2_10	Categorical	1-9	1 - Excellent 2 - Very good 3 - Good 4 - Fair 5 - Poor 7 – Don't Know 8 – Refused 9 – Not stated
Eating habits	Fs2eh2	Categorical – recoded *	1-2	1 – Very good or excellent (1-2) 2 – Good, fair, or poor (3-5) Missing – (7-9)

Canadian Community Health Survey– Rapid Response on Food Skills (Part 2) – Mechanical Skills and Food Conceptualization, 2013				
Concept:	**Related variables of interest**	**Type of variable**	**Range**	**Description of the variable Values - Categories**
Main Meal at home When preparing the MAIN meal at home, which of the following ^YOURFAMILY do the most often? By main meal we mean the meal of the day that requires the most preparation.	FS2_20	Categorical	1-9	1 - You use mostly whole basic foods such as vegetables, fruits, pasta, legumes and meat 2 - You use mostly easy to prepare foods such as frozen lasagna 3 - You use a mix of whole basic foods and easy to prepare foods 4 - You buy ready-to eat food or order takeout or delivery 7 – Don't know 8 – Refused 9 – Not stated
Main meal	Fs2mm2	Categorical – recoded *	1-2	1 - Mostly whole foods (1) 2 - Not mostly whole foods (2-4) Missing – (7-9)
Ability to cook - basic ingredients How would you describe your ability to cook from basic ingredients? Would you say:	FS2_30	Categorical	1-9	1 - I don't know where to start when it comes to cooking 2 - I can do things such as boil an egg or cook a grilled cheese sandwich but nothing more advanced 3 - I can prepare simple meals but nothing too complicated 4 - I can cook most dishes if I have a recipe to follow 5 - I can prepare most dishes 6 - I frequently prepare sophisticated dishes 97 – Don't know 98 – Refused

Canadian Community Health Survey– Rapid Response on Food Skills (Part 2) – Mechanical Skills and Food Conceptualization, 2013				
Concept:	**Related variables of interest**	**Type of variable**	**Range**	**Description of the variable Values - Categories**
				99 – Not stated
Cook from basic ingredients	Fs2bi2	Categorical – recoded *	1-2	1 – High (3-6) 2 – Low (1-2) Missing – (97-99)
Skills - Using a kitchen knife safely How would you rate your skills: in using a kitchen knife safely?	FS2_40	Categorical	1-9	1 - Very good 2 - Good 3 - Basic 4 - Very limited/ No skills 7 – Don't Know 8 – Refused 9 – Not stated
Skills – Knife	Fs2kn2	Categorical – recoded *	1-2	1 – High (1-2) 2 – Low (3-4) Missing – (7-9)
Skills - Peeling, chopping, slicing vegetables or fruit How would you rate your skills: in peeling, chopping or slicing vegetables or fruit?	FS2_50	Categorical	1-9	1 - Very good 2 - Good 3 - Basic 4 - Very limited / No skills 7 – Don't Know 8 – Refused 9 – Not stated
Skills - Peeling, chopping, slicing	Fs2pcs2	Categorical – recoded *	1-2	1 – High (1-2) 2 – Low (3-4) Missing – (7-9)
Skills - Freezing veg. or fruit from raw in home freezer (How would you rate your skills:) in freezing vegetables or fruit, from raw to bagged in your home freezer?	FS2_60	Categorical	1-9	1 - Very good 2 - Good 3 - Basic 4 - Very limited / No skills 7 – Don't Know 8 – Refused 9 – Not stated

Canadian Community Health Survey– Rapid Response on Food Skills (Part 2) – Mechanical Skills and Food Conceptualization, 2013				
Concept:	**Related variables of interest**	**Type of variable**	**Range**	**Description of the variable Values - Categories**
Skills – Freezing	Fs2fr2	Categorical – recoded *	1-2	1 – High (1-2) 2 – Low (3-4) Missing – (7-9)
Canning from raw in sealed glass jars (How would you rate your skills:) in canning from raw ingredients to finished products in sealed glass jars?	FS2_70	Categorical	1-9	1 - Very good 2 - Good 3 - Basic 4 - Very limited / No skills 7 – Don't Know 8 – Refused 9 – Not stated
Skills – Canning	Fs2ca2	Categorical – recoded *	1-2	1 – High (1-2) 2 – Low (3-4) Missing – (7-9)
Cooking piece of raw meat/chicken/fish (How would you rate your skills:) in cooking a piece of raw meat/chicken/fish?	FS2_80	Categorical	1-9	1 - Very good 2 - Good 3 - Basic 4 - Very limited / No skills 7 – Don't Know 8 – Refused 9 – Not stated
Skills – Meat	Fs2mt2	Categorical – recoded *	1-2	1 – High (1-2) 2 – Low (3-4) Missing – (7-9)
Skills - Soup, stew or casserole from scratch How would you rate your skills: in cooking a soup, stew or casserole from scratch?	FS2_90		1-9	1 - Very good 2 - Good 3 - Basic 4 - Very limited / No skills 7 – Don't Know 8 – Refused 9 – Not stated
Skills – Stew, Soup, Casserole	Fs2soup2	Categorical – recoded *	1-2	1 – High (1-2) 2 – Low (3-4)

Canadian Community Health Survey– Rapid Response on Food Skills (Part 2) – Mechanical Skills and Food Conceptualization, 2013				
Concept:	**Related variables of interest**	**Type of variable**	**Range**	**Description of the variable Values - Categories**
				Missing – (7-9_
Skills - baking muffins/cake using pre-packaged mix (How would you rate your skills:) in baking muffins or cake using a pre-packaged mix?	FS2-100		1-9	1 - Very good 2 - Good 3 - Basic 4 - Very limited / No skills 7 – Don't Know 8 – Refused 9 – Not stated
Skills – Baking from mix	Fs2mix2	Categorical – recoded *	1-2	1 – High (1-2) 2 – Low (3-4) Missing – (7-9)
Skills - baking muffins or cake from scratch with a recipe (How would you rate your skills:) in baking muffins or cake from scratch with a recipe?	FS2_110	Categorical	1-9	1 - Very good 2 - Good 3 - Basic 4 - Very limited / No skills 7 – Don't Know 8 – Refused 9 – Not stated
Skills – Bake from scratch, recipe	Fs2scratch2	Categorical – recoded *	1-2	1 – High (1-2) 2 – Low (3-4) Missing – (7-9)
Adjust a recipe to make it healthier Have you ever adjusted a recipe to make it healthier?	FS2_120	Categorical	1-9	1 - Yes 2 - No 7 – Don't know 8 – Refused 9 – Not stated If FS2_Q120 =1, go to FS2_Q130. Otherwise, go to FS2_Q140.

Canadian Community Health Survey– Rapid Response on Food Skills (Part 2) – Mechanical Skills and Food Conceptualization, 2013				
Concept:	**Related variables of interest**	**Type of variable**	**Range**	**Description of the variable Values - Categories**
Adjust a recipe, healthier	FS2_120	Categorical – recoded *	1-2	1 – Yes 2 – No Missing –(7-9)
How did you make it healthier? Made it healthier - added more veg. or fruit	FS2_130 FS2_130D	Categorical	1-9	1 - Yes 2 - No 7 – Don't know 8 – Refused 9 – Not stated
How did you make it healthier? Added more vegetables or fruit	Fs2addfv	Categorical – recoded *	1-2	1 – Yes 2 - No Missing – (7-9)
Grow vegetables, herbs or fruits in home or community garden When season permits, do you grow vegetables, herbs, or fruits at home or in a community garden?	FS2_140	Categorical	1-9	1 - Yes 2 - No 7 – Don't know 8 – Refused 9 – Not stated
Garden	FS2_140	Categorical – recoded *	1-2	1 – Yes 2 - No Missing – (7-9)
Province of residence of respondent	GEO_PRV	Categorical; nominal	10-59	10 - Newfoundland and Labrador 11 - Prince Edward Island 12 - Nova Scotia 13 - New Brunswick 24 - Quebec 35 - Ontario 46 - Manitoba 47 - Saskatchewan 48 - Alberta 59 - British Columbia
Total household Income from all sources	INCDHH	Categorical; nominal	1-15	1 - NO INCOME 2 - LESS THAN $5,000 3 - $5,000 TO $9,999

Canadian Community Health Survey– Rapid Response on Food Skills (Part 2) – Mechanical Skills and Food Conceptualization, 2013				
Concept:	**Related variables of interest**	**Type of variable**	**Range**	**Description of the variable Values - Categories**
				4 - $10,000 TO $14,999 5 - $15,000 TO $19,999 6 - $20,000 TO $29,999 7 - $30,000 TO $39,999 8 - $40,000 TO $49,999 9 - $50,000 TO $59,999 10 - $60,000 TO $69,999 11 - $70,000 TO $79,999 12 - $80,000 TO $89,999 13 - $90,000 TO $99,999 14 - $100,000 TO LESS THAN $150,000 15 - $150, 000 OR MORE
Total household income from all sources	Inc4	Categorical – recoded *	1-4	1 - <$30,000 2 - $30,000-$59,999 3 - $60,000-$89,999 4 - >$90,000
Highest level of education – household, 10 types	EDUDH10	Categorical	1-9	1 – Grade 8 or lower (Que. Sec ii or lower) 2 – Grade 9-10 (Que. Sec iii, iv; NFLD sec 1) 3 – Grade 11-13 (Que. Sec v; NFLD sec2-3) 4 – Secondary school grade., no post sec 5 – Some post secondary 6 – Trade's certificate or diploma 7 – Diploma/ certificates – college/ CEGEP 8 – Univ. Certificate below bachelor's level 9 – Bachelor's degree

Canadian Community Health Survey– Rapid Response on Food Skills (Part 2) – Mechanical Skills and Food Conceptualization, 2013				
Concept:	**Related variables of interest**	**Type of variable**	**Range**	**Description of the variable Values - Categories**
				10 – Univ. degree or cert. above bac. Level 99 – Not stated
Highest level of education – household, 6 types – recategorized	Edudh06	Categorical – recoded *	1-6	1 - Less than secondary school graduation (1-3) 2 - Secondary school graduation (4) 3 - Some post-secondary (5) 4 – Trades (6) 5 - Certificate/ diploma/ < bachelor's degree (7-8) 6 - ≥Bachelor's degree (9-10) Missing – (99)

Note: Variables represented in table are from the Canadian community the health survey, rapid response on food skills (Part 2) – mechanical skills and food conceptualization, data set (Statistics Canada, 2013c).

* Recoded variables as used in data analyse.